

MANUAL
OF
AUSCULTATION
AND
PERCUSSION:

TRANSLATED FROM THE FRENCH OF

M. M. BARTH AND ROGER,

BY

J. H. POTTENGER, M. D.,

ST. LOUIS.

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A MANUAL
OF
AUSCULTATION AND PERCUSSION,
AS APPLIED TO THE
DIAGNOSIS OF DISEASES
OF THE
Heart and Lungs, and to Pregnancy;

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TRANSLATOR'S PREFACE.

The Translator of the following pages would state as his reason for submitting them to the consideration of the Profession, the superior intrinsic merit of the original work, and the complete exhaustion of the translations of Dr. NEWBIGGING, of Edinburg, and Dr. F. G. SMITH, of Philadelphia, the only two, it is believed, that have heretofore appeared in the English language.

Contemplating the repetition of a Course on Auscultation the coming winter, and desirous of forestalling the embarrassments experienced by his class the past summer, arising from the want of a systematic treatise on this subject, the undersigned has devoted a few leisure hours to the translation of the *Resume* and other portions of the last edition (1860) of the "*Traite Pratique d'Auscultation*," and now respectfully submits the result to his professional brethren, in the confident belief that in it they will find nothing to condemn, but every thing to commend rather; for it is a faithful transcript, in English, of the original, than which no other work ever issued from the Medical press, has enjoyed a higher degree of favour, as its adoption by the "*Council of Public Instruction for the Faculties of*

Medicine" in France, as the Text Book in Auscultation, most fully attests.

As its title implies, the Manual is designed rather for the student and those desirous of reviving their knowledge of the subject of which it treats, than for the proficient in Auscultation. Hence, every thing has been carefully avoided in the book not absolutely practical in its nature, and susceptible of daily confirmation, by even the partially advanced student, at the bedside of a proper patient.

In introducing into the work the several tables and other matters found only in the body of the original, it was thought an additional interest would thus be imparted to it, and that, by facilitating his study, it might stimulate the student into whose hands the book may fall, to more diligent research in this simple, essential and most attractive branch of Diagnosis.

For the tables "exhibiting the physical cause and ordinary seat of the various physical signs," &c., adapted to the text of MM. BARTH and ROGER, the Translator is indebted to the work of Dr. WALSHE, of London, the idea of their introduction here, however, being first suggested by the excellent little book of Dr. FRANCIS G. SMITH, of Philadelphia.

J. H. P.

FIFTH AND CHESNUT STS., {
ST. LOUIS, Oct. 15th. }

M A N U A L OF AUSCULTATION AND PERCUSSION.

IMPORTANCE OF AUSCULTATION.

It is deemed unnecessary to institute a comparison between Auscultation and the other physical methods of interrogating disease : its superiority becomes the more evident from the exposition of stethoscopic facts themselves. Let us rather content ourselves by summing up its advantages in the form of the following propositions :

1st. Auscultation reveals to us whether disturbance observed during the act of respiration is symptomatic of disease in the thorax, or of another affection more or less remote from this cavity ;

2d. It discloses alterations in the thoracic viscera, even in the absence of any functional disorder :

3d. Not only does it demonstrate the existence of disease, but it acquaints us with its intensity, extent, progress, complications, and, sometimes, its nature ;

4th. It enables us at times to make our diagnosis with wonderful rapidity, and with a degree of certainty and accuracy almost mathematical ;

5th. It leads us to the discovery of lesions which, without it, might completely escape our observation : for instance—in the child not yet able to speak, or who expresses imperfectly his feelings ; in certain complicated diseases, when the affections of several organs mask each other ; when the patient is delirious or comatose ; in all cases, finally, when the physician can get no information regarding the case, how greatly do the value of functional

symptoms and the signs appreciable to our senses become enhanced by auscultation !

Nor is this all : it renders *direct* aid by affording us a more intimate acquaintance with the disease and its progress, and, consequently, with its prognosis ; it sometimes directs us also to its semiology in an *indirect*, but not less effectual manner : thus, by the aid of the signs obtained in our examination of the chest, auscultation unveils the nature of certain affections of cephalic and abdominal organs. To render this proposition more intelligible, let us cite a few examples. A patient complains of pain in the belly, and is occasionally troubled with vomiting ; his abdomen is augmented in volume, and we discover thickening of its parietes and dulness upon percussion in its more declivitous portions : to what affection do these symptoms point ? Is it chronic peritonitis ? If so, is this peritonitis simple in its character, or is it complicated with another and graver lesion ? If auscultation reveal in this patient the signs of pulmonary tubercles, does not our diagnosis of the abdominal affection become simplified in a marked degree, and is there not great probability that the case before us is one of *tubercular* peritonitis ?

Another patient has been suffering for several days with fever, slight colicky pains and diarrhœa ; although these symptoms would seem referable exclusively to an intestinal disorder, auscult your patient's chest : if you hear a sonorous rale in both lungs, you should suspect the commencement of a typhoid fever, for pulmonary catarrh is a very rare complication of *simple* enteritis, and a very common one of the *follicular* form of this disease. Finally, suppose the case of a child complaining at first of pains in the

head; it is next seized with fever and vomiting; after these, delirium and convulsions show themselves. If the stethoscope reveal in this case the signs of tubercles in the lungs, can we fail to ascribe the symptoms stated to *tubercular meningitis*?

By throwing light upon, and thus perfecting semiology, are we not contributing in a powerful degree to the advance of the healing art? And, in this point of view, how great is the obligation owed by the profession to auscultation! A consecutive statement of facts alone will prove the great advantage that has been derived from this method in the *treatment* of diseases; and a few examples will suffice to demonstrate the aid afforded by it daily to the physician, the accoucheur, and even to the surgeon. Is it not auscultation which, by establishing a precise distinction between pneumonia, pleurisy and bronchitis, has furnished us the means of applying an appropriate medication to each of these diseases, so long confounded? In revealing the existence of latent pleurisy, formerly so common, has it not taught us to combat a disease, the more dangerous in proportion as its existence is the less suspected? By the aid furnished us by auscultation, the treatment of asthma is now become more rational, and consequently more effective; pulmonary phthisis, recognized in its incipency, is no longer incurable; lesions of the pericardium and of the heart, may be discovered in their earliest stage, and thus organic disease be prevented. Finally, thanks to the stethoscope and the pathognomonic sounds it brings to the ear, chlorosis is now distinguishable in an easy and positive manner from affections of the heart, which it simulates, and an uncertain and sometimes fatal treatment is substituted by a medication always safe and most commonly salutary.

Again, it is by the information obtained through the stethoscope that the accoucheur is frequently directed in his manœuvres, and the surgeon in his operations; this same information again directs the operator in the choice of time and place when the necessity for paracentesis-thoracis presents itself. In hernia of the lung, wounds of the chest with effusion, fracture of the ribs with emphysema, or traumatic pneumo-thorax, vesicular calculi, certain cases of tumour situated upon the track of an artery, &c., does not auscultation, by aiding us in our diagnosis, impart more of certainty to our treatment, and consequently enhance its chances of success? There are other circumstances in which it renders to the surgeon aid not less marked: thus he is taught by it in the most positive manner the existence of thoracic complications in surgical diseases, and the consequent necessity for a change in his plan of treatment. At other times it dissuades him from the performance of an unnecessary and even fatal operation upon a patient affected with advanced phthisis, or with an aneurism about to burst; to cite but a single example of this: Sir Astley Cooper, because of his failure to have recourse to auscultation of the chest, once lost, from the rupture of an aneurism of the aorta, a man in whom he had tied the crural artery. (1)

Let us take care however, not to exalt auscultation at the expense of the other modes of clinical examination, and neglect the services these are capable of rendering us. The stethoscope fails in some cases, either because the disposition of material lesions opposes the production, or

(1) Chrestien, *De la Percussion et de l'Auscultation dans les maladies chirurgicales*, these de concours, 1842, p. 151.

the perception of the physical sign ; or else, their complex character is betrayed by several sounds ; or, lastly, because the various rales do not present themselves with sufficiently distinctive characters. In such cases then, auscultation has need of the aid and confirmation of the other methods. All the senses, aided and presided over by reason, should assist in the solution of that difficult problem, known by the appellation of disease : without this indispensable concurrence of the senses and the reasoning faculties, the diagnosis would repose upon an uncertain basis only. Auscultation, therefore, is not responsible for the errors of those who accord to it a confidence too exclusive, or of those who make bad use of the data it affords.

Certain routinists have reproached it with being more hurtful than useful to therapeutics, by paralyzing the activity of the physician, who, having satisfied himself by its aid of the existence of organic lesions, often incurable, confines himself to this portion of his task. But is it just to accuse science, if the man who is charged with the application of treatment to the result she furnishes him, stops midway in his duty, and leaves his task unfinished ? This same reproach addressed to auscultation had previously been visited upon pathological anatomy : it is equally unjust to both. Auscultation, properly understood, should inspire the physician with confidence, and not discourage him. The more precise notions with which it furnishes him, will enable him to apply to diseases the plans of medication the best adapted to them ; and as to the expectant method which it sometimes commands him to adopt, this should never degenerate into *a meditation upon death*.

GENERAL RULES.

Auscultation has certain general rules which it is proper to observe, to the end that its results should become at the same time more perceptible and more available to the physician. Some of these rules have reference to the patient, whilst others relate to the medical practitioner.

RULES RELATIVE TO THE PATIENT.—A. The part to be auscultated should be bare, or covered with a thin and soft garment only, in order that the stethoscope may be accurately applied without causing friction, and the sounds easily reach the ear. Thick garments, and those made of wool particularly, prevent us from hearing the respiratory murmur, except in children, in whom the respiration is naturally very noisy. Coverings of silk also are improper, by reason of the rustling sound they give forth under the ear. It is better then to have nothing covering the chest but the shirt or chemise, or merely a towel to protect the patient from taking cold.

B. The person to be auscultated should be in a convenient position, which will vary according to his disease and the region to be examined. Of this we shall speak more particularly hereafter.

RULES RELATIVE TO THE PHYSICIAN.—A. The physician should ordinarily place himself on the side of his patient he is about to examine: sometimes he will find it more convenient to place himself on the opposite side—for example, on the right, when he is about to examine the sounds of the heart. Generally, he will find it convenient to examine both sides of the chest without changing his position. In those cases, however, where the result of his examination appear to him doubtful,

he should place himself successively on the right and on the left of his patient, and auscultate. Whatever be his position, he should auscultate the anterior region with one ear and the posterior with the other, thus habituating himself early to the use of both ears indifferently.

B. Auscultation may be *immediate* or *mediate*, that is to say, it may be practised with the naked ear, or with the stethoscope. Laennec attached too much importance to the instrument, for it is not in the stethoscope that the merit of auscultation resides; and the cylinder adds nothing whatever to the excellence of the method. Whether we study the acoustic phenomena which take place in the living body by means of the ear applied directly to the chest, or through the medium of a conducting body, the results are identical. It is not necessary to proscribe or to adopt exclusively either one or the other of these modes: both have their advantages, and the choice between them will depend upon several different conditions.

The *ear* takes in sounds over a greater extent, because every portion of the head brought in contact with the chest becomes an additional conducting medium. But immediate auscultation should not be of constant and general usage. A sense of delicacy may deter the physician from applying his head to the anterior portion of the chest of the female. In certain parts, as the axilla, the supra and sub-clavicular regions, the supra-spinous fossæ, the groin, &c., it is difficult to apply the ear with exactness, particularly in patients of very thin habit. In persons who are dirty, or those covered with sweat, the disgust inspired might tend to render immediate auscultation impracticable. This inconvenience disappears, however, if a towel be placed between the ear and the walls of the chest.

With the *stethoscope*, which, moreover, we have not always at our command, the number of the sounds heard is less ; but it has the advantage of being applicable to points which the ear reaches with difficulty only. It circumscribes the sounds better, and marks their limits with more precision, though this same end may be attained by the well practised ear.

In a word, mediate is no more to be preferred than immediate auscultation, and *vice versa*. They should each be employed in turn by the physician who seeks to establish the correctest and completest diagnosis, in order that he may prescribe the most rational and most effective treatment. The choice to be made between the two methods will vary—1st, *according to individuals*. The stethoscope is almost entirely inapplicable to children, who become frightened by it ; it is to be preferred in females, though in men its use is indifferent : 2d, *according to the point to be examined*. Posteriorly, the ear is more easily applicable ; anteriorly there is but little room for choice between the two. Upon depressed regions the stethoscope is almost exclusively employed ; it alone is employed in the auscultation of certain organs, such as the larynx, the trachea, the abdominal aorta, &c. : 3d, *according to the nature of the sounds*. For the perception of certain acoustic phenomena the instrument is to be preferred, for others the ear ; the former answers better in certain circumscribed lesions, such as pulmonary apoplexy and caverns ; the ear, in diseases whose extent is greater, such as bronchitis and pleurisy.

The form of the stethoscope and the wood of which it should be made, do not possess the importance ascribed to them by Laennec. The moment it ceases to be regarded as an ear-trumpet, or more than an instrument to be pre-

ferred in some cases to the ear, on account of its greater convenience of application, the better will it fulfil its conditions of convenience, and the more useful will it become. The original cylinder is now generally abandoned, the stethoscopes of MM. Louis and Piorry having supplanted it. These instruments are composed of a hollow cylinder of cedar or ebony from six to eight inches in length, and one to two in width at its base ; its diameter is narrower in its upper three-fourths, and it is terminated above by a round plate of ivory perpendicular to its axis, intended for the ear to rest upon. This plate may be of the same wood as the tube, and the stethoscope thus constructed of one single piece is that to which we give the preference.

This instrument has been subjected to numerous modifications. M. Piorry himself has endeavored to make it more perfect, by substituting metal for wood, in order to diminish the diameter of the cylinder. M. Landouzy has proposed a stethoscope with several branches so as to admit of several auscultating at the same time. Some have replaced the horizontal plate by a projecting extremity capable of introduction into the tube of the ear ; others have invented bent stethoscopes so as to examine patients in every point without requiring them to change their posture, and, if need be, to auscultate themselves.

Dr. Giraud has recently proposed a *flexible* stethoscope.(1) This instrument, composed of a bell shaped arrangement, and of an ebony plate, adjusted to the two ends of a caoutchouc tube about twenty-six or thirty inches in length, possesses the advantage of being easily applicable to points

(1) This stethoscope appears to be the reproduction of a similar instrument, constructed some twenty years ago by M. Charriere, at the request of M. Vigier.

but little accessible to the ordinary stethoscope, and of saving the patient a degree of pressure sometimes inconvenient. But on account of the length of the tube, the sounds are lost or reach the ear very materially weakened.

To remedy this inconvenience, and at the same time preserve the advantages arising from the flexibility, we have adapted a shorter tube to the two ends of an ordinary stethoscope, cut in half: with this modification, the sounds arrive a little more distinctly at the ear, but they are still so much diminished by the difference in density of the conducting media, that the imperfection of the acoustic instrument is not compensated by the convenience of its application.

It is now seen how much value is to be attached to these pretended improvements. In our judgment the best stethoscope is that we have above described.

If, in auscultating, the ear be preferred, it should be accurately applied, so as to follow the movements of expansion and contraction of the chest, without rubbing against the surface with which it is in contact. If the stethoscope be used, it should be held as a pen, perpendicularly to the region to be examined, a uniform surface to which it may be accurately applied being selected as a *point d'appui* for the instrument: then, maintaining it thus in position by means of the fingers, which should remain immovable, the pavillion of the ear is to be applied to the horizontal plate of the instrument: if the external air find its way, either between the skin and the instrument, or between this latter and the ear, it will produce sounds which may mask those of the air passages. Care should be taken to press moderately; too strong a pressure, however, whilst it may

be prejudicial to our hearing properly, might be painful to the patient, and attended with an aggravation of certain of his symptoms, such as dyspnoea, pain, &c., and even alter, it may be, the nature of the acoustic phenomena.

We should never fail to *auscultate both sides comparatively*. By such comparison alone we will sometimes be enabled to detect slight alterations, which, without it, might escape our observation: and by thus acquainting ourselves with the healthy regions as a type, the slightest modifications presented in diseased points are brought out in the stronger relief.

It is scarcely necessary to add that perfect silence should surround the examiner; that he should auscultate a sufficient time to enable him to concentrate his attention, and thus isolating himself from the external world, fix his mind upon the pathological interpretation of the sounds which reach his ear. With practice, he may accustom himself not only not to hear the sounds occurring around him, but even to select from among several acoustic phenomena the particular one upon which he should mainly fix his attention.

These precepts given, let us place the pupil at the bedside of a patient. What moment shall he select for auscultating? Where shall he commence his examination, and how far conduct it? What precautions must he adopt to arrive the most speedily and the most certainly at a knowledge of the acoustic phenomena? Finally, what steps must he pursue in order to determine exactly their value?

In general it is necessary for him to pass from the simple to the complex, and in the study of physical signs, it is proper to begin with those whose appreciation is easiest. Thus, for the chest, it is natural to examine first its con-

formation and its movements, and to ascertain with certainty the degree of sonority of its walls : then he should proceed to auscultate, with the chance of losing the least possible time in feeling his way. He should proceed precisely as though the patient were unable to respond to his questions. If, on the contrary, he is able to communicate information, the examiner should gather this previously, because it may serve as a guide to him : it will at least prevent him from delaying, unnecessarily, in the application of the other physical methods of examination, and lead him directly to the object he has in view, by designating the apparatus or portion of this which he should first of all explore. If, for example, he is led to examine the chest, the seat of pain, when any exists, will indicate to him the side in which he may expect to discover morbid phenomena. Let us suppose now that his ear is applied to the left side of the chest : how, if he has but little experience, is he to judge of the nature of the sounds he hears ? These sounds may be produced in the oesophagus or the stomach, in the circulatory system, or in the organs of respiration ; in the latter case they may depend upon the resonance of the voice, of the cough, or of respiration alone. Now, the signs furnished by the voice or the cough are so intimately connected with these same acts themselves, that it is difficult to mistake them : it remains then only to decide whether the sounds belong to the air passages, the heart, or to the superior portion of the digestive tract. Those of the oesophagus and the stomach have a peculiar tone, and are a sort of gurgling produced by the displacement of gas. To distinguish whether the phenomenon in question belongs to the circulation or the respiration, the observer must ascertain whether the sound is repeated sixty or eighty

times the minute, or only sixteen or twenty times : generally speaking the distinction will be easy ; but the phenomenon, whether it be the effect of the action of the heart or of the lungs, may manifest itself at intervals only, and then this rule is no longer applicable : in this case the observer must satisfy himself whether it is immediately dependent upon the movements of respiration or of the heart ; whether it is synchronous with the expansion of the chest, or with the pulsations of the radial artery. Where its connection with the respiration is established, he must ascertain in what it differs from the normal respiratory murmur ; whether this difference refers to the force, rhythm or character, or whether it constitutes one of those abnormal sounds designated as rales or rhonchi : if so, whether the rale be dry or moist ; whether its bubbles burst during the act of inspiration only, or in both this and expiration ; their size, number, &c.

He will thus by degrees succeed in recognizing the sound he seeks ; but as many rales, the *sub-crepitant* for example, are found in a large number of diseases, the physician should not, from a single acoustic fact, be willing to establish a definite diagnosis : he should endeavour rather to appreciate the various shades, intensity, seat and extent of this sign ; inform himself of the other stethoscopic phenomena ; weigh well the concomitant physical signs, the general and local functional symptoms, the circumstances in which the morbid accidents have developed themselves, their progress, and, finally, all the physiological and pathological conditions of the patient. It is only by the reunion of all these various elements and their attentive comparison, that he will be enabled to establish his diagnosis upon a correct basis.

DIVISION.

Auscultation of the chest constitutes of itself alone nearly the whole science of stethoscopy, and comprises the alterations of the viscera, which, with the brain, form the *tripod of life*. In order to facilitate its study, we shall separate the auscultation of the *respiratory apparatus* from that of the *circulatory organs*. Whatever the sympathy existing between these two sets of organs in their diseased states, the lesions to which they are liable are not the less distinct for this, and the physical phenomena by which these lesions are betrayed constitute also two separate and very distinct orders.

CHAPTER FIRST.

AUSCULTATION OF THE RESPIRATORY APPARATUS.

The auscultation of the respiratory apparatus is practised upon the *thorax* or the *laryngo-tracheal* tube. Its end is the study of the three sets of phenomena furnished by the *respiratory murmur*, *the voice*, and *the cough*.

RESPIRATORY MURMUR.

Particular Rules.

When we desire to examine the modification of the respiratory murmur, we place the patient in different positions according to the points of the chest we wish to explore. For the examination of the *anterior part*, he may stand upright, his arms hanging close to his body; or he may be seated on a chair or in his bed, though the dorsal decubitus

is preferable, because in this position the breast reposes upon a firmer support. For the *posterior part*, if the patient be erect, or seated on a chair—or, better still, in his bed, he should cross his arms or bring them in front of him. Sometimes, when he is too weak, he may be made to lie down upon his belly, or rather upon his side. In every case the tension of the muscles should be only moderate, and the position of the body *symmetrical*; the shoulders should be on the same plane, the head straight or sometimes slightly inclined forward, sometimes backward; sometimes it should be made to turn alternately to one side and the other, but always with this precaution, that the displacement be always absolutely the same on both sides. For the auscultation of the *lateral portions* of the chest, the patient should repose upon the side opposite to that we desire to examine: whether he be abed, or seated on a chair, or upright, the arm of the side to be examined should be rested on his head. Sometimes it becomes necessary to place the patient in exceptional positions, upon all fours, for example, when we desire to ascertain whether a liquid contained in the pleural sac is displaced by changes in his position.

The patient should breathe freely, that is, without an exaggerated effort or making a noise with his mouth, and without holding his breath, two extremes into which persons frequently fall, either through fear or ignorance, or in the belief that something extraordinary is demanded of him.

The observer, therefore, to guard himself against the possible deception of a too strong or too feeble respiration, should not fail to inspect, previous to auscultating his patient, the manner in which the movements of the chest

are executed in the act of respiration. It sometimes becomes necessary that the patient should increase these movements, or expand the thorax to its fullest extent, in order that the more rapid passage of air, or its more complete penetration into the air cells of the lungs, may render certain sonorous phenomena, otherwise indistinct, more perceptible, or produce others which, without this, might remain entirely unheard. There are some people whom you cannot cause to respire as you desire: if you tell such to cough whilst you auscultate, your end is gained, for each effort at coughing is preceded and followed by a deep inspiration, during which the acoustic phenomena become more evident. With the same object in view, it has been recommended to make the patient talk or read several passages. In the child, particularly, it is very difficult to obtain a spontaneous exaggeration of the respiratory movements; the cough is more easily provoked in them. But with the exceptions now named—which demand an excess of respiration so to speak—we should endeavour to control the respiration on the contrary, and make this regular and natural, because ill-timed efforts may serve only to increase the intensity of the pain, or change the true character of the sounds.

The *physician* should choose for himself the most convenient position with reference to the patient. If he be incommoded, it will be impossible for him to maintain his ear in contact with the different regions of the chest; and if his head be too low, the afflux of blood there will render his hearing obtuse.

As to the choice between the ear and the stethoscope, the *place* to be examined will decide this. Anteriorly and superiorly, in the supra and sub-clavicular regions, the

cylinder will be preferred; in emaciated patients the stethoscope only is sometimes applicable. Lower down it is better to rely upon the ear, except in the case of females whose breasts, by reason of their volume, may prove an obstacle. Posteriorly, we may auscultate *immediately* from the base of the chest up to the spine of the scapula: the cylinder is not of easy application upon a convex surface, its trumpet shaped end being liable to be elevated by the least movement of the breast. In the supra-spinous fossa, if the patient be very thin, the stethoscope has the advantage. Upon the lateral portions of the chest, except in the axillæ, the ear alone may be more conveniently used.

As to the *sound* to be perceived, although the instrument is preferable to determine its precise seat, its exact limit and the maximum of its intensity, the ear, with very little practice, will bring us to the same result. In vices of conformation of the chest, as in ricketty children, for example, sometimes it is the stethoscope, sometimes the ear that is most applicable, according to the disposition of the deformed parts. In a rapid examination, the stethoscope is not to be recommended, for, as it embraces but a limited surface, it demands too much time for a complete exploration.

The capital principle in auscultation—that *both sides of the chest should be comparatively examined, and in corresponding points*, is specially applicable to the chest: a single example will demonstrate the importance of this precept. Let us suppose that one of the two pleural sacs contains a slight effusion, which causes in the diseased side a slight diminution of the respiratory murmur, and in the healthy exaggerated respiration. From an incomplete examination we might be led to the belief that the disease exists in the

point where the respiration is loud, merely because it is supplemental; and contenting ourselves with this first glance, thus take as an index of alteration a sign which is simply an excess of the normal type. It is also proper that the examination should embrace the whole chest, and that the observer should refrain from the expression of an opinion upon the case until he shall have auscultated every part thereof during several inspirations at least.

AUSCULTATION.

ART. 1—RESPIRATORY MURMUR.

§ I. Normal Respiration.

If, in the physiological state, the ear be applied to the chest of a man whilst he breathes, a slight murmur will be heard, similar to that produced by a person whilst calmly sleeping, or when he heaves a deep sigh: this is the *natural respiratory sound or vesicular murmur*. A soft and gentle sound to the ear, it is composed of two distinct periods, that of *inspiration*—the louder and more prolonged, and that of *expiration*.

The vesicular murmur is strongest at those points corresponding to a greater degree of thickness of the lungs: it is somewhat ruder over the root of the bronchial tubes (*normal bronchial respiration*.) Of equal intensity on both sides of the chest, in corresponding points, it is, in some persons, slightly more marked at the summit of the right lung. Louder when the respiration is full and rapid, it is heard with increased force in infants (*puerile respiration*;) whilst, on the contrary, it is more feeble in many aged persons. Generally, its intensity may be said to be proportionate to the capacity of the chest and the thinness of its parietes.

§ II. Alterations of the Respiratory Murmur.

These may be divided into four orders: 1 alterations in *intensity*; 2 in *rhythm*; 3 in *character*; 4 by *abnormal sounds*.

(I.) Table of the Alterations of the Respiratory Murmur.

ALTERED RESPIRATORY MURMUR.	I. IN ITS INTENSITY.....	{ A. Loud respiration. B. Feeble respiration. C. Absent respiration.
	II. IN ITS RHYTHM. {	{ 1. Frequency { Frequent respiration. { Slow respiration. 2. Continuity.... Interrupted respiration.
	3. Duration.....	{ Long respiration. Short respiration. Prolonged expiration.
	III. IN ITS CHARACTER.....	{ A. Rude respiration. B. Bronchial respiration. C. Cavernous respiration. D. Amphoric respiration.
	IV. BY ABNORMAL SOUNDS {	1st. Genus Friction sound.
		2d. Genus.... .. Rales (vide table II.)

1. ALTERATIONS IN INTENSITY.

Considered in this respect the respiration may be *loud*, *feeble* or *absent*.

A. **LOUD OR PUERILE RESPIRATION.**—This consists in a vesicular murmur of greater intensity than is heard in the normal state, but preserving the soft and gentle character peculiar to the respiratory murmur. It announces less a lesion of the pulmonary organs in the point at which it is heard, than disease in a portion of the lungs more or less removed from this, the healthy tissue compensating for the inaction of the parts in a diseased state.

B. **FEEBLE RESPIRATION.**—It is characterized by a diminution in the normal force of the vesicular murmur, which sometime preserves its natural softness, sometimes becomes ruder. It depends either upon the incomplete transmission of the respiratory sound to the ear, or else upon the lesser degree of intensity with which this sound is produced.

In the first case it may be due to *pleuritic effusion*, to *thick false membranes* deposited upon the pleural surfaces, or to the presence of *tumours* which push the lung from the thoracic parietes. In the second it may be ascribed to *pleurodynia*, *stricture of the larynx*, *partial obstruction of one or more of the bronchial tubes* by pellets of mucus, or by a foreign body; finally, to the *constriction* of their cavities, or the *compression* of their parietes by tumours. It is also met with in *pulmonary emphysema* and in the *first stage of phthisis*.

Of all the diseases just enumerated, and which are often revealed by feebleness of respiration, tubercles, pulmonary emphysema and liquid effusions into the pleural sac, being

by far the most frequent (bronchitis, also very common, has its special rules,) the physician should almost exclusively fix his attention upon them. If feebleness of the vesicular murmur coincides with exaggerated resonance of the chest, there is emphysema: if with dulness on percussion, there are tubercles or pleuritic effusion; if feeble respiration, accompanied with dulness on percussion, be limited to the summit of the lung, we have to do with tubercles; if it be circumscribed at the base, there is pleuritic effusion; if it exist at the summit of both lungs, there is almost certainly tubercles in both these organs; if it be found at the base of both lungs, we have double pleurisy, or else double hydrothorax.

C. ABSENCE OF RESPIRATION.—The respiration is said to be absent when the ear, applied to the chest, hears absolutely nothing at all; the vesicular murmur is now wanting, and no sound whatever replaces it: the silence is complete.

Absence of respiration depends upon the same material conditions as the feeble respiration, and, consequently, it announces the same diseases, with this difference—that it indicates the anatomical lesions to be more developed. But the complete silence of the respiratory murmur being exceptional in emphysema and in tubercles;—diseases of the larynx declaring themselves by particular signs;—obliteration of the bronchial tubes, their obstruction by foreign bodies, as well as pneumo-thorax without perforation, etc., being rare affections in comparison with liquid effusions in the pleural sacs, it results that the absence of respiration is a sign of very great value, and a frequent index of such effusions; and, as most frequently pleurisy is simple and hydrothorax double, it follows as a consequence, that the silence

of the respiratory murmur, confined to one side only of the chest, announces with almost positive certainty a pleurisy with effusion.

2. ALTERATIONS IN RHYTHM.

The respiration altered in its rhythm, may be *slow* (from twelve to seven respirations the minute) as in several diseases of the *cerebro-spinal apparatus*; or *frequent* (from thirty to eighty) as in a great number of thoracic or abdominal affections. Sometimes it is *interrupted*, as in asthma, pleurodynia, incipient phthisis, chronic pleurisy with adhesions, etc.

Sometimes it is *long*, sometimes *short*; sometimes, finally, there is *prolonged expiration*, and, when this is the case, the respiratory murmur is almost always at the same time of a ruder character than normal. Of these alterations, the last alone possesses importance in a diagnostic point of view. It may be said that *prolonged expiration is the indication of two diseases only*, pulmonary emphysema and crude tubercles. In some cases it is the first or the only stethoscopic sign furnished us of phthisis.

3. ALTERATIONS IN CHARACTER.

A. RUDE OR HARSH RESPIRATION.—It presents variable degrees of force, of harshness and dryness, and these alterations may affect both acts of respiration or one only.

Rude respiration is heard in *emphysema of the lung*, in *incipient phthisis*, in all cases finally attended with *pulmonary induration* (melanosis, chronic pneumonia, etc). Of all these diseases, *emphysema* and *phthisis* are those in which rudeness of the respiratory murmur is most frequently heard. If this rudeness be associated with dryness, vaulting of the thoracic parietes and exaggerated resonance

upon percussion, we diagnose *pulmonary emphysema*. Is the rude respiration accompanied with prolonged expiration? Is it limited to the summit of the chest, and have we at the same time increase of vocal resonance and dullness upon percussion? In this case our diagnosis should be *crude tubercles*.

B. BRONCHIAL OR TUBULAR RESPIRATION (TUBULAR, BRONCHIAL BLOWING).—Remarkable at the same time for an augmentation in its intensity and a higher tone, the bronchial respiration may be very closely imitated by blowing through the hand, arranged in the form of a tube, or through a stethoscope: the more forcibly and quickly we blow thus, the more closely we approach the true tubular respiration.

When it is only slightly marked, bronchial respiration differs very little from *rude* respiration, of which indeed it is but a higher degree. Well marked, it has a peculiar *tubular* tone which serves to distinguish it generally from *cavernous respiration*, the which has generally a *hollow* character altogether peculiar. Bronchial respiration may be heard in a great number of affections of the pleuræ, of the bronchial tubes, and especially of the lungs—such as *inflammatory hepatization*, *extensive collections of tubercular matter*, *pulmonary apoplexy*, etc.; *in liquid effusions into the pleural sacs*, and *various tumours compressing the lungs*; finally, *dilatation of the bronchial tubes with induration of the tissue surrounding them*.

Of all these diseases the most habitual are pulmonary phthisis, pleurisy and pneumonia. If the bronchial respiration be but slightly marked, circumscribed at the summit of the chest, and have supervened on a chronic disease, it should be at-

tributed to the presence of crude tubercles in the parenchyma of the lung. If the sound be more intense, and if it be associated with symptoms of acute disease in the chest, our attention must be immediately directed to pleurisy or pneumonia. If it be not proportioned either to the intensity or the extent of dulness on percussion, it should be regarded as the indication of a pleuritic effusion. If, on the contrary, it be intense, true tubular blowing; and if it be perceived throughout the whole extent of the chest accompanied with dulness on percussion, we have every reason to believe in the existence of pulmonary hepatization.

C. CAVERNOUS RESPIRATION (CAVERNOUS BLOWING).—It resembles the sound produced by blowing into a hollow space. It may be imitated by blowing with force in the two hands disposed in the form of a cavity. Its favorite seat is the summit of the chest. It announces either an *extensive dilatation of a bronchial tube*, or the existence of a *cavern*, properly so called. But, owing to the infrequency of bronchial dilatations of this extent, and of pulmonary excavations as the result of abscess, gangrene, etc., compared with the frequency of phthisis, we may conclude that, *nine times in ten, the cavernous respiration indicates a cavern, resulting from the breaking down of tubercles.*

D. AMPHORIC RESPIRATION.—This is a very loud, resonant sound, of a metallic tone, and which may be very well imitated by blowing into a large empty jar, or into a decanter with resonant walls. It almost always coincides with *metallic tinkling*.

Amphoric respiration *well characterized, indicates almost infallibly a pneumothorax with pulmonary fistula. Less well marked, it may announce this same disease, but it may*

(II.) Table of the Abnormal Sounds of Respiration.



(1st class)	SOUND OF FRICTION : <i>Pleuritic Friction.</i>	
(2d class)	{ (1st group.) Dry Rales (vibratory.)	{ Sonorous Rale... .. { <i>Sibilant.</i> <i>Snoring.</i>
RALES...	{ A. <i>Crepitant Rale.</i>	{ <i>Fine Sub-Crepitant.</i> <i>Medium Sub-Crepitant.</i> <i>Large Sub-Crepitant.</i>
{ (2d group.) Moist Rales (bullar.)	{ B. <i>Sub-Crepitant Rale.</i>	
	{ C. <i>Cavernous Rale.</i>	
ABNORMAL		
SOUNDS.		
Appendix . {	{ <i>Crackling.</i> <i>Pulmonary crumpling, etc.</i>	

ABNORMAL

SOUNDS.

also be the indication of a large cavern, almost always of tubercular origin.

4. ALTERATIONS PRODUCED BY ABNORMAL SOUNDS.

The abnormal sounds are of two classes: *rales* and the *friction sound*.

1st GENUS—FRICTION SOUND.

PLEURITIC FRICTION.—The two folds of the pleura, which, in the movements of the lung, glide *silently* one upon the other in the normal state, no longer do so when certain pathological conditions are present, but perform their functions then with a certain degree of *noise*, a *sound* quite appreciable to the attentive ear. This *pleuritic friction* is closely analogous to the sound produced by crumpling a piece of parchment more or less dry: it is ordinarily interrupted, and is composed as it were, of several successive cracklings. It offers varieties of harshness and of intensity which have given rise to the distinctions into soft or *gentle*, harsh or *grating* friction sound. When it is strongly marked it is sometimes perceptible even to the hand applied to the thorax: sometimes, in such cases, the patient himself even becomes sensible of it. For the production of the friction sound, it is necessary that the pleural surfaces, or at least one of these, present certain asperities or roughnesses, and that these glide over each other in the movements of elevation and depression of the ribs. These asperities depend almost always upon the presence of false membranes deposited upon the membrane.

We have the pleuritic friction in *pleurisy*, in certain cases of *tubercles of the pleura* without adhesion, in certain other *organic alterations of this membrane*, and very rarely in some

varieties of *pulmonary emphysema*. But this phenomenon most frequently indicates a pleurisy in progress of cure. If it be heard exclusively at the summit of the chest, it justifies the suspicion of tubercular pleurisy.

2d GENUS—RALES.

1. **RALES** are abnormal sounds, which, formed during the act of respiration by the passage of air through the air passages, mingle with the respiratory murmur, obscuring it, and sometimes even entirely taking its place. We divide them into two groups, one called *dry* or *vibratory*, because they consist of variable sounds; the other *humid* or *bullar*, because they are characterised by bubbles.

1. **VIBRATORY OR DRY RALES.**—We comprise under this appellation the two principal varieties of the *sonorous rale*—the *acute sonorous* or *sibilant*, and the *grave sonorous* or *snoring*. The first consists in a more or less acute whistling; the second is characterized by a musical sound more grave in its tone, and which resembles the snoring of a man in deep sleep—or, better still, the sound produced by the base chord of a violin when made to vibrate by the touch. Often heard together, these two rales sometimes alternate with and replace each other.

The sonorous rale may be heard in a great number of diseases, such as *inflammation* or *catarrh of the bronchial tubes*, either *acute* or *chronic*, *pulmonary emphysema*, and *compression of the air passages* by tumours situated along their course—different morbid conditions all, but all of them possessing one common element, to-wit: temporary or permanent narrowing in some point or another of the air passages. By reason of the frequency of bronchial catarrh and the comparative rarity of the other morbid conditions just

enumerated, in which the snoring or whistling manifests itself, the sonorous rale announces almost positively an inflammatory or congested condition of the bronchial tubes.

2. MOIST, BULLAR, RALES.—These comprise the crepitant, sub-crepitant and cavernous rales.

A. CREPITANT RALE.—The *crepitant* or *vesicular* rhonchus or rale furnishes to the ear the sensation of a fine and dry crepitation, analogous to the sound produced by the crackling of salt when sprinkled over a metallic surface slightly heated; or to that heard by the compression between the fingers of a piece of lung containing air; or to that caused by the gentle friction between the thumb and forefinger of a lock of hair, held near the ear. Its bubbles, perceived exclusively in inspiration, are very small, very numerous, uniform in volume, and somewhat dryish in character. Its favorite seat is the posterior and inferior portion of the chest, on one side only.

The crepitant rale is heard in *pneumonia*, in certain forms of *pulmonary congestion*, in *œdema*, and in *apoplexy of the lungs*.

By reason of the extreme frequency of inflammation of the lung, and the comparative rarity of œdema and apoplexy of this organ, the crepitant rhonchus, especially when it is well marked, is almost the pathognomonic sign of pneumonia in the stage of engorgement.

B. SUB-CREPITANT RALE (MUCOUS, MOIST, BRONCHIAL RALE.)—This rale has been correctly compared to the sound produced by blowing through a tube, one end of which is immersed in soap-suds. The variable volume of its bubbles justifies its division into *fine*, *medium*, and *large* or *coarse* sub-crepitant; the number of its bubbles and their

characters are likewise very variable. It is heard both in inspiration and expiration, and its seat of election is the posterior and inferior portion of the chest, on both sides.

The sub-crepitant rale may be heard in a large number of diseases, such as *bronchitis in its second stage*, the different kinds of *catarrh of the pulmonary mucous membrane*, *dilatation of the bronchi with excessive secretion*, certain forms of *congestion* and of *pulmonary apoplexy*, and *phthisis* at the commencement of softening of the tubercles. Of all these affections, the two most frequent being bronchitis and tubercles at the period of softening, the manifestation of the sub-crepitant rale should direct our attention in an especial manner to these two diseases; and it is the knowledge of the seat of election of the rale that serves as our guide in the diagnosis. If the bubbles, very numerous at the base of the two lungs, diminish in proportion as our ear is made to approach the summit of the chest, the existence of bronchitis is almost certain; if, on the other hand, these bubbles being absent or few in number at the base of the thorax, are heard more marked in the upper portion of the chest, and on one side only more especially, and become more and more evident and numerous in proportion as we approach the summit with our ear, our diagnosis should unhesitatingly be, tubercles in the stage of softening.

C. CAVERNOUS RALE (GURGLING.)—This rale is constituted by bubbles, few in number, large, unequal in size, and *mixed with cavernous respiration*. It is this admixture which constitutes its distinctive character. Heard both in inspiration and expiration, it is ordinarily limited to the summit of one or both lungs. Sometimes the rhonchus, although seated in the superior portion of the chest, is

characterized by smaller bubbles of a clearer, more distinct tone, without the admixture of cavernous respiration: this is the *cavernicular rale*, or that indicating a very small cavern.

The cavernous rale announces the existence of a *pulmonary excavation* communicating with the bronchial tubes, or else, a *bronchial dilatation in the form of a cavern*. If it coincide with cavernous voice and be seated at the summit of the lung, it indicates almost infallibly *tubercular excavation*.

APPENDIX.

There yet remain certain abnormal sounds, differing from those now described, and imparting to the ear the sensation of *rustling* in the lung, of a *plaintive cry*, or of the dull flapping of a valve. These phenomena, though rare, are referable generally to *pulmonary excavations*.

or crumpling.

Another, and last sound, however, belonging to this class, and of much greater importance, consists of a succession of little *crackling* sounds, which, at first *dry*, sooner or later become *moist*, are perceived ordinarily at the summit of the chest, and are one of the most characteristic signs of *tubercles commencing to soften*.

ART. II.—AUSCULTATION OF THE VOICE.

§ 1. Particular Rules.

To the precepts already announced (pages 6 and 14) we will add a few special rules which our observation has taught us to be useful for our government when auscultating the voice. What has already been said respecting the position the patient should occupy, is applicable here,

though the sitting posture is that generally selected, because it is in the posterior region more particularly that we auscultate the voice. In order that the vocal phenomena may be appreciable, the patient should speak with a certain degree of force, and give to the sounds of his voice an uniform measure of intensity, whilst the different points of his chest are undergoing examination. It is the general custom to make him count or read aloud, so that the voice shall be sustained and uniform, and that the ear, always judging by comparison, may be the better able to appreciate justly the morbid modifications in its intensity and tone.

The use of the ear or the stethoscope is not a matter of indifference here. The former is better adapted in bronchophony, which is a diffused phenomenon, and in ægophony, which we ordinarily seek at the inferior angle of the scapula, a region where the application of the cylinder would be difficult and inconvenient. On the other hand, we prefer the stethoscope where we have pectoriloquy, because the phenomenon is limited, and one of its characters is the transmission of articulate sounds through the instrument. If the cylinder be used, Laennec recommends that it be supplied with his obturator: this precaution seems to us unnecessary. The pressure of the head upon the instrument, or upon the chest, should be moderate, and of the same degree on both sides: too strong a pressure renders the vocal resonance less pure and less distinct; whilst an insufficient amount of pressure changes its nature, giving to it a bleating character. Finally, it is often useful, in order to appreciate clearly the morbid phenomena of the voice, to keep the disengaged ear closely stopped up while we are auscultating.

AUSCULTATION OF THE VOICE.

When we auscultate the larynx of a man whilst he is speaking, the vocal sounds reverberate along the stethoscope, and strike the ear with force. Over the trachea this resonance is somewhat less marked, and when we descend to the chest, it becomes but a confused buzzing sound. The *natural resonance* of the voice, which represents exactly all the varieties of the voice itself, is the more intense in proportion as the latter is louder and more sonorous, the nearer to the bronchial tubes we examine, the greater the capacity of the chest, and the thinner its walls. It is equal in the corresponding points of both sides, and somewhat more marked towards the summit of the right lung, by reason of the greater diameter there of the right bronchus.

In the *pathological state*, the vocal resonance is sometimes merely *exaggerated*; sometimes it undergoes modifications in its character, and we then have *bronchial*, *bleating*, *cavernous* or *amphoric* voice.

A. EXAGGERATED RESONANCE OF THE VOICE, OR SLIGHT BRONCHOPHONY, is characterized by a resonance of the voice somewhat louder than in the normal state, and is but one degree inferior to the *bronchial voice* (*true bronchophony*). It is associated, ordinarily, with similar alterations, though less extensive and less marked.

B. BRONCHIAL VOICE is much louder than the normal resonance. It is remarkable for its intensity, its extent, its localization and its permanence. It coincides almost invariably with bronchial respiration. It may be heard in *dilatation of the bronchiæ*, in *pleurisy*, and, above all, in *induration of the lung*. But, owing to the *infrequency* of dilatation of the bronchiæ, this sign *almost always announces*

(III.) Table of the Pathological Phenomena of the Voice and Cough.



1. PATHOLOGICAL PHENOMENA OF THE VOICE. {
- A. Exaggerated Resonance.
 - B. Bronchial Voice or Bronchophony.
 - C. Bleating Voice or *Ægophony*.
 - D. *Cavernous* Voice or *Pectoriloquy*.
 - E. Amphoric Voice.

2. PATHOLOGICAL PHENOMENA OF THE COUGH. {
- A. Bronchial or Tubular Cough.
 - B. Cavernous Cough.
 - C. Amphoric Cough.

3. PHENOMENA FURNISHED BY THE RESPIRATION, THE COUGH AND THE VOICE. {
- Metallic Tinkling.

pulmonary induration. *Now, of all the alterations where the density of the lung is increased, pneumonia and tubercles are incomparably the most common cause. The conditions for the production of the bronchial voice being better fulfilled in pneumonia than in phthisis, it is better marked in the former of these diseases than in the latter. It exists only exceptionally in pleurisy, and if it be well marked and extensive here, it should lead to the suspicion that the pleuritic effusion is complicated either with pneumonia or tubercular induration.*

C. BLEATING VOICE (*ÆGOPHONY*) is a peculiar resonance of the voice which seems to be pitched in a higher key, and is marked by a certain degree of tremulousness and abruptness in its tone. We might almost fancy sometimes that the patient speaks with a counter between his lips and his teeth (*polichinello voice*). This sign is generally heard on one side of the chest only, and in the inferior half of the sub-spinous fossa: even though it occupy a more considerable extent, in this point still it is always most distinctly heard: it may change its seat according as the patient changes his position, and coincides almost always with feebleness or absence of the vesicular murmur at the base of the chest.

True ægophony indicates almost always a *serous effusion in the cavity of the pleura*. *If it be perceived on one side only, with fever, we have pleurisy to deal with; if on both sides of the chest, without fever, and with general dropsy, the case is one of hydrothorax. If it appear in the course of inflammation of the pulmonary parenchyma, and if it shift its seat in consequence of the changes of position of the patient, it announces a pleuro-pneumonia.*

D. CAVERNOUS VOICE (*PECTORILOQUY*).—We have

the *cavernous voice* when, in examining a patient in the act of speaking, the vocal vibrations seem to be concentrated in a hollow space, the walls of which send back to the ear the sounds of the voice more or less distinctly articulated. It is in general in the superior portion of the chest that we discover this sign, and it coincides either with the cavernous rale, or else with cavernous respiration.

The *cavernous voice*, like cavernous blowing, indicates the existence of a *pouch-like dilatation of a bronchus, a tuberculous, pneumonic, apoplectic, or gangrenous cavity*. Owing to the rarity of bronchial dilatations and of pulmonary excavations, independent of phthisis, compared with the frequency of these excavations in consumptives, we are justified in the immense majority of cases in pronouncing the cavernous voice a sign of tubercular excavation.

E. AMPHORIC VOICE.—It is characterized by a resonance altogether similar to the metallic and hollow buzzing sound produced by speaking with the lips closely applied to the mouth of a large jug one-fourth filled with liquid. It coincides ordinarily with amphoric respiration, and, like this sign, announces a *pneumo-thorax*, and, more rarely, an immense pulmonary excavation.

ART. III.—AUSCULTATION OF THE COUGH.

The semiological value of the cough is less than that of the voice, as that of the voice is less than that of the respiration. We have seen, in fact, that there is not a single material lesion of the pulmonary organs, even though it be but slightly marked, which does not reveal itself in the immense majority of cases by one or several alterations of the

respiratory sound, and that some of these morbid phenomena have a very precise signification : several indeed, such as the crepitant rale, amphoric respiration, and cavernous blowing are almost pathognomonic signs. Another advantage presented by the pathological phenomena of respiration, and which renders them of great value on account of the certainty they impart to diagnosis, is that their study, though this be prolonged, is not attended with fatigue to the patient, he not even being called upon to lend to the examination the concurrence of his will.

The same cannot be said respecting the stethoscopic signs furnished by the auscultation of the voice. Besides being less numerous, their characters are much less precise, and resemble each other frequently to such a degree as to cause great confusion in distinguishing between them. Their utility, then, in a semiological point of view, is more restricted, and when their manifestation is not very evident, they possess often less importance by themselves than when in combination with other phenomena : it is thus that certain morbid modifications, almost valueless if they be isolated, become significative only by their association with the alterations of the respiratory sound or the resonance of the thoracic walls. For example, suppose a slight resonance of the voice be perceptible at the summit of the chest, its pathological signification will be very vague if it be considered alone, and possesses a well determined value only when there are united with it rudeness of the respiratory murmur or thoracic dulness. Besides, the production of the vocal phenomena is, frequently, impossible : the infant unendowed with reason, a patient in delirium, in a state of coma, or completely prostrated by disease, or one who has lost his voice, cannot render the least assist-

ance to his physician, who thus finds himself deprived of one of his resources ; even those patients who are able to lend him their aid, sometimes soon tire of speaking, and the examination then cannot be continued except with inconvenience. *Autophony*, in these cases, compensates but slightly for these defects in the auscultation of the voice. It is worse still for the auscultation of the *cough*. The signs which it affords are scarcely obtained with more facility, and if sometimes they be rapidly perceived, their number is too restricted, and, with a very few exceptions, the certainty attaching to their characters is too slight, to suffice for the diagnosis, unless we shall, in advance, have enlightened ourselves by an investigation of the phenomena of respiration and the voice. Most frequently the cough only serves to control or confirm our first judgment. Therefore we shall not enlarge on the application of the stethoscope here, which is become almost unnecessary, for the reason that the knowledge of the respiratory sounds and of the voice, confirmed by the results obtained by percussion, suffice to establish a certain diagnosis.

The cough adds to semiology, therefore, very few positive sounds of its own : it is rather a means of provoking the manifestation of abnormal sounds, the physical conditions of which are already in existence. By reason of the fact that it is accompanied with a more rapid expiration ; that it is preceded and followed by a more energetic inspiration, it reveals or exaggerates certain phenomena which otherwise might not have been produced, or, if so, but indistinctly. Accordingly, to assure ourselves whether the respiration be natural, we have said the rule is to cause patients to cough who do not know how to breathe properly : the long inspiration which necessarily precedes the

cough enables us to decide whether the feebleness or absence of the vesicular murmur be real or only apparent. This precept especially applies to children, whose respiratory movements we are incapable of directing.

The same may be said respecting the humid rales. As these are caused by the passage of air through liquid contained in the air passages, they will the more surely be produced, and become all the more perceptible, in proportion to the rapidity with which the elastic fluid is made to traverse the tubes: thus the crepitant rale, which is hardly perceptible in the ordinary expansion movement of the thorax, becomes quite manifest in the deep inspirations accompanying cough. Hence the importance of causing the patient to cough at the commencement or the close of pneumonia, and in partial sanguineous or serous engorgements of the lung, in order that the air may be made to penetrate the greatest possible number of cells, and reveal to the ear phenomena which, without this excess of respiration, would have remained absent, or too feeble to be perceptible. At other times, a temporary obstacle opposes itself to this manifestation, by changing the material conditions of the parts, as, for example, an accumulation of mucus plugging up the communication between a bronchial tube and a cavity: if, in this case, we make our patient cough, and thus, by expelling the morbid secretion, re-establish the communication, the cavernous rale or blowing returns with the original conditions of its production.

In some circumstances we are enabled to learn by the cough whether a phenomenon be permanent or transitory, by satisfying ourselves whether it persists or ceases after this act, and after the expectoration which follows it. Thus, the respiratory sound which appears enfeebled in one

point, owing to the momentary obstacle to the passage of air through the tubes caused by an arrest of the sputæ, will show itself again in its natural character after the expulsion of these mucosities: if, on the other hand, the feebleness of respiration persists after the patient shall have coughed, it indicates a permanent lesion, tubercles for example. In like manner the sonorous and sub-crepitant rales, dependent upon the accidental presence of mucus in the air passages, will disappear upon the evacuation of the bronchial secretion; whereas the continuance of these abnormal sounds should lead us to suspect alterations more fixed, and consequently, more serious.

The cough aids us in the differential diagnosis of several phenomena which resemble each other, and in the determination of their precise seat. We have observed that pleuritic friction, in one of its forms, offers a very close resemblance to the dry crepitant rale, and that it is often difficult to distinguish the true cause of two sensations so strikingly analogous. Cause your patient to cough, and if you discover that the abnormal sound persists without modification, the sign is that of *friction* passing in the pleura, and is entirely independent of the air tubes: if, on the contrary, the morbid phenomenon ceases after expectoration, or if it be materially modified by the shock imparted to the air in the lung, we should regard it as a rale formed in the ramifications of the bronchial tubes.

If, then, by the number and the value of its signs, the cough possesses only a medium importance, it frequently becomes, nevertheless, an useful auxilliary; it oftentimes proves, also, an advantageous means of abridging the stethoscopic examination: thus, a single shock of cough is sometimes sufficient to render evident certain phenomena

whose exact appreciation would have required several successive inspirations ; and this rapidity of exploration is a valuable resource in the cases of those too feeble to endure a prolonged investigation, or in children too impatient to submit to the delay of a complete examination.

After these preliminary considerations, there is but little to add in explanation of the mode of procedure in the investigation of acoustic facts revealed by the auscultation of the cough. The greater part of the rules we have laid down respecting the auscultation of the voice are applicable here. Let us remark, however, that there are people who know no more how to cough than they do to respire : they cough from the back of their throats only, and the cough does not resound in the thorax. In such cases we should engage our patients to heave a deep sigh, so as to cough from the *bottom of the chest*, and thus impart a strong shock to the whole column of air.

The following are observed to be the *physiological phenomena* attendant upon the cough : the ear applied to the chest perceives at the moment of the cough a dull and confused sound, accompanied by a shock which shakes the pectoral cavity. This mixed phenomenon of impulse and sound, more easily appreciable by the senses than describable, is the more perceptible in proportion as it passes nearer the ear, or in the larger bronchial tubes, and to the force with which the patient coughs : it is less sensible under the opposite conditions. The cough heard over the larynx and the trachea, and at the root of the bronchiæ in persons of narrow chest, is cavernous in its character, and conveys the sensation of hollowness, or of the rapid passage of air through a tube.

AUSCULTATION OF THE COUGH.

When we apply our ear to the chest of a healthy person, we perceive, during the act of coughing, a dull and confused sound, accompanied with a shock, which reverberates through the pectoral cavity. This mixed phenomenon of impulsion and sound is the more perceptible the nearer it is produced to the ear or the larger the bronchial tubes, and in proportion to the force with which the patient coughs. The cough heard over the larynx and the trachea, and in persons of narrow chest, as also at the root of the bronchiæ, has somewhat of a cavernous character, and suggests the idea of the rapid passage of air through a tube.

In the *pathological state* the cough presents special characteristics: it is *bronchial* or *tubular*, *cavernous* and *amphoric*. When the cough is *tubular* the ear experiences the sensation which a column of air would furnish on traversing with great noise, force, and rapidity tubes with solid walls. It manifests itself in the same conditions as bronchial respiration, and is dependent, like the latter, upon *pulmonary hepatization*.

The *cavernous cough* consists in a louder and, especially, a more hollow resonance than that of the normal cough. It imparts a highly characteristic shock to the ear of the observer, applied to the chest, *and is one of the most positive signs of a pulmonary cavern*.

The *amphoric cough* is characterized by a very marked metallic resonance. In combination with the amphoric respiration and voice, this sign announces the existence of a *pneumo-thorax*, or a *vast pulmonary excavation*.

METALLIC TINKLING.

This name is given to a slight sound of a silvery tone,

either unique or multiple as to the number of its bubbles, similar to the sound produced by letting drop one or several grains of coarse sand into a large metallic cup, or to that given forth by gently striking with a pin a cup made of metal, glass or porcelain. It accompanies the respiration and the voice, but is generally more manifest during the cough. It announces the existence either of a *very large pulmonary cavity*, a *pneumo-thorax*, or a *hydro-pneumothorax* with or without *fistulous communication of a bronchial tube*.

By reason of the rare occurrence of a cavern sufficiently spacious to afford well marked metallic tinkling, this phenomenon when well characterised indicates almost always a pneumothorax. As effusions of gas into the pleural sac exist very rarely without at the same time an accumulation of liquid, or pulmonary perforation, the metallic tinkling, if capable of being constantly produced and of well marked character, by both the respiration and the voice, becomes almost a pathognomonic sign of a hydro-pneumothorax with fistulous communication between the pleural surface and a bronchial tube.

SOUND OF THORACIC FLUCTUATION.

In the physiological state, succussion produces no sound in the chest ; but when there exists in the pleural cavity a liquid effusion with air, the collision of these fluids, produced by suddenly shaking the trunk of the patient, or by his own spontaneous movements, conveys to the ear of the auscultator a clacking sound perfectly analogous to the noise produced by shaking a decanter half full of water. This phenomenon is sometimes so well marked that it may be heard at a distance even : it almost always accompanies **amphoric** respiration and metallic tinkling, and, like these

signs, it indicates a *pneumo-hydrothorax* or an *immense pulmonary cavern half filled with liquid*.

ART. IV—AUSCULTATION OF THE LARYNX.

In the *normal state* the *respiratory sound* heard in the larynx possesses a hollow and cavernous tone, the *vocal resonance* is at its maximum, and the *cough* conveys the sensation of the rapid passage of air through a hollow space.

In the *pathological state*, the laryngeal respiratory murmur is harsher, more *grating*, as in cases of acute or chronic laryngitis; or it is supplanted by a *whistling* sound, as in spasm or oedema of the glottis, in stridulous laryngitis, in some cases of the presence of foreign bodies in that tube, and in compression of the trachea; or by a *sonorous cry*, as in cases of laryngeal ulceration, with much thickening of the edges of the ulcers, forming a barrier to the entrance of air; or, again, by a *humming* noise, as in simple or stridulous laryngitis, ulcerations, vegetations of the organ, etc., which sound, in croup, has frequently a *metallic tone*.

In some cases, the ear perceives a *laryngeal cavernous rale*; when, for example, the trachea and larynx are filled with mucus: this rale may be more circumscribed, and be dependent upon the presence of mucus over an ulcer, or around a foreign body lodged in the ventricles of the larynx, etc. Finally, in some rare cases, we detect a species of *trembling*, which indicates the existence of croup, with loose false membranes.

There is yet another sign met with in a great number of diseases of this organ, which is recognized, it is true, by the auscultation of the chest, but which deserves mention

here: we refer to the *diminution or complete absence of the vesicular murmur*. This phenomenon arises in the course of any alteration of the physiological condition of the larynx involving a considerable obstruction to the introduction of air into the air passages, whether by obstructing or narrowing the diameter of those passages (swelling, inflammation, vegetations, accidental products, foreign bodies, etc.; or whether by their compression from without inwards, (cancerous tumours, cysts, aneurisms, etc.); finally, by producing more or less complete occlusion of the superior orifice of the air tube (hypertrophy of the tonsils, polypus of the nasal fossa falling back upon the superior portion of the larynx, etc).

SIGNS DISCOVERABLE BY AUSCULTATION OF THE RESPIRATION.

Name of the sign.	Physical cause.	Ordinary Seat.	Diseases in which observed.
Respiratory murmur.	Entrance of air into pulmonary vesicles.	Periphery of the lungs.	In health, it is soft and gentle to the ear, analogous to the sound made in heaving a deep sigh. It is composed of two distinct sounds, that of <i>inspiration</i> —the more prolonged, and that of <i>expiration</i> .
Exaggerated or puerile respiration.	Increased rapidity of the passage of air into the lungs. It indicates less a lesion of the organ at the point where it is heard, than disease elsewhere in it; the healthy tissue taking on a supplementary action.	This varies: it may occupy a part or the whole of either lung.	<div><div>the seat of bronchitis: Where there is obstruction of a principal bronchial tube by a foreign body: Condensed by tubercles: Apoplectic effusion: Melanosis: Pneumonia: Pleuritic effusion: Int'l thoracic tumours. Chronic consolidation of lung: Pulmonary emphysema</div><div>In healthy tissue bordering on.</div></div>

Feeble respiration.	Impediment to the entrance of air.	Varies: a part or the whole of a lung.	Pleuritic effusion. Thick false membranes deposited on the pleura. Tumours removing the lung from the thoracic walls. Pleurodynia. Stricture of the larynx. Partial obstruction of one or more of the tubes by a collection of mucus or a foreign body: contraction of their diameter, or compression of their walls by tumours. Pulmonary emphysema, and first stage of phthisis. Most common in the first and last two named diseases.
Absence of respiratory murmur.	Same as last, though more pronounced.	Same as last.	Same as last.
Slow respiration.	Retarded action of respiratory muscles.	Whole of both lungs.	Disease of the cerebro-spinal axis

Name of the sign.	Physical cause.	Ordinary seat.	Diseases in which observed.
Frequent respiration.	Deranged hæmotosis	The whole lung.	Probable extensive and grave lesion of thoracic organs.
Interrupted respiration.	Interference with the due expansion of the chest from pain or the presence of pleuritic adhesions.	Whole of one lung, infraclavicular region only.	Incipient phthisis. Pleurodynia. Asthma. Chronic pleurisy with adhesions.
Harsh respiration.	Condensed pulmonary tissue, and dryness of the bronchial mucous membrane.	Varies.	Emphysema. Incipient phthisis, and all cases attended with thickening of pulmonary tissue.
Prolonged respiration ^{respiration} .	In the physiological state, the air leaves the lung easily and without obstacle, and, consequently produces but a	Generally at the top of one lung, though sometimes of both, and in other parts of the chest.	First stage of phthisis. Pulmonary Emphysema.

short sound ; but when morbid productions, such as tubercles, are infiltrated through the pulmonary parenchyma, these bodies form prominences in the final bronchial ramifications, and the air in its departure meets with these obstacles which increases the friction, from which there results an increase in the force and duration of the expiratory murmur.

Name of the sign.	Physical cause.	Ordinary seat.	Diseases in which observed.
Bronchial respiration	Condensation of pulmonary substance.	Varies; though generally at summit and base of chest.	Tubercular infarction of the lungs. Second stage of pneumonia. Pleuritic effusion. Dilatation of a bronchus with condensation of surrounding tissue. Apoplexy of lung. Tumours.
Cavernous respiration.	Entrance of air into a dilated bronchus; or a cavern in the substance of the lung.	Top of one or both lungs. Root of the organs. Other portions of same.	Tubercular caverns. Dilated bronchus. Pneumonic abscess.
Amphoric respiration	Entrance of air into a large cavern through a bronchial tube, above any liquid that may there be contained.	Varies; though commonly in the subclavicular region, and the middle of the lateral portion of the chest.	Very large tubercular cavern. Pneumo-thorax with pulmonary fistula. Pneumonic abscess.

Gentle friction sound.	Asperities on one or both pleural surfaces, which, in the act of respiration, glide over each other.	Varies, not only in different individuals affected with the same disease, but also in the same patient from day to day. Oftenest at the angle of the scapula, and under the clavicle.	Pleurisy in its forming stage, and tubercular phthisis at summit of the lung. Also towards the <i>end of pleurisy</i> , when the absorption of the liquid admits the coming together again of the two serous layers.
Harsh friction sound.	Non-adherent, thick, false membranes.	Same as preceding.	Pleurisy, same as above.
Sibilant rale.	Modification of the form and size of the bronchial tubes temporarily, by the presence of tenacious mucus. Permanent alteration in the calibre of the tubes arising from exterior pressure.	Often over both sides, and either anteriorly or posteriorly. Sometimes over a circumscribed extent.	Acute or chronic bronchitis. Pulmonary emphysema. Tumours in the lungs or at their root, compressing the tubes.

Name of the sign.	Physical cause.	Ordinary seat.	Diseases in which observed.
Sonorous rale.	Same as preceding.	Same as preceding.	Same as preceding.
Crepitant rale.	Presence of liquid in the air cells and minute ramification of the bronchial tubes, and passage of air through this.	Variable, though most commonly at the base of but one lung, posteriorly only.	First and third stages of pneumonia. Pulmonary congestion. Oedema of the lungs. Pulmonary apoplexy.
Sub-Crepitant rale.	Passage of air thro' liquid in larger bronchial tubes than the last alluded to.	Variable, though most common in the posterior part of the lungs, and under the clavicle.	Second stage of bronchitis. Pneumonia in progress of resolution. Certain congestions of the lungs. Phthisis at the commencement of softening.
Cavernous rale.	Passage of air thro' liquid contained in a hollow space in the lung. The bubbles are larger, more numerous and more irregular	Summit of one or both lungs. Central part of lung. Indifferently in any part of lung.	<div style="display: flex; align-items: center;"> <div style="font-size: 3em; margin-right: 10px;">{</div> <div> <p>Tubercular excavation.</p> <p>Dilatation of bronchus.</p> <p>Excavation from abscess, gangrene, softening of cancer. Pulmonary apoplexy</p> </div> </div>

	Cavernicular rale.	than the last, and accompanied with cavernous respiration.	Passage of air thro' liquid contained in smaller space than last. The bubbles are smaller, more distinct, and there is no cavernous respiration.	Summit of one or both lungs.	
Pulmonary crackling	Passage of air thro' liquid in smaller bronchial tubes.	Summit of either or both lung.	Tubercles commencing to soften.		Small tubercular cavity.

SIGNS DISCOVERABLE BY AUSCULTATION OF THE VOICE

Name of the sign.	Physical cause.	Ordinary seat.	Diseases in which observed.
Weak vocal resonance.	Diminished conducting power of substance of the lung or presence of a non-conducting medium between the lung and the walls of the chest.	Anterior surface of either side (especially the left); also the base of both lungs posteriorly.	Atrophic vesicular emphysema. Pneumo-thorax.
Absence of vocal resonance.	Presence in the pleural cavity of a material incapable of conducting the sonorous vibrations. (air).	Middle height of the chest.	Extensive pneumo-thorax.
Bronchophony.	Unnatural density of the pulmonary tissue surrounding the bronchi. Presence of an induration	At summit of lung. At the base commonly, and posteriorly; sometimes at the summit. Cent-	Infiltration of tubercular matter. Pneumonia, 2d stage. In pleurisy with effusion. In solidification of lung from any cause

	ed adventitious mass in same situation. Dilated bronchus.	tral height usually variable.	whatever.
Ægophony.	A thin stratum of fluid compressing the lung, and commonly (but not necessarily) contained in the pleura.	The neighborhood of the inferior angle of either scapula (rarely both), and a few inches on the side, in a line with that point.	Pleurisy with effusion. Hydrothorax. Pleuropneumonia.
Pectoriloquy.	The existence of a hollow space in the lung, presenting certain conditions conducive to free vibration of sound.	Summit of one or both lungs. Central portion. Variable.	Tubercular excavation. Dilated bronchus. Excavation from abscess, gangrene, &c., &c.
Amphoric voice.	The existence of a large cavern containing air and fluid and communicating with a bronchus.	Same as amphoric respiration.	

SIGNS DISCOVERABLE BY AUSCULTATION OF THE COUGH.

Name of the sign.	Physical cause.	Ordinary seat.	Diseases in which observed.
Bronchial cough.	Unnatural density of pulmonary substance; compression by fluid; enlarged bronchus.	Summit. Base posteriorly and opposite root of the bronchi. Central height.	Phthisis. Pneumonia. Pleurisy. Dilatation of bronchus. Chronic consolidation of lung.
Cavernous cough.	Same	Same as cavernous respiration.	
Amphoric cough.	Same	Same as amphoric respiration.	
Metallic tinkling.	Drops of fluid falling into a liquid contained in a large cavity.	Central height latterly or posteriorly, whence it may be propagated with diminishing intensity to the surrounding parts: may be heard in every part of the chest.	Pneumo-hydrothorax with bronchial fistula. Very large tubercular cavity: Pneumo-hydrothorax, without fistula (very rare)

Thoracic fluctuation.	Collision of air and liquid in large space, caused by succussion of the trunk, or the vountary movements of the patient	Postero-lateral region	Immense pulmonary cavern partly filled with liquid. Pneumo-hydrothorax. It nearly always accompanies amphoric respiration and metallic tinkling.
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AUSCULTATION OF THE LARYNX. (After Dr. F. G. Smith.)

Harsh laryngeal respiration.	Passage of air along the surface of rough or ulcerated mucous membrane; altered so through a larynx altered in form by external pressure.	Opposite the larynx, extending a certain distance into the trachea.	Acute and chronic laryngitis, with or without ulceration or diminution of calibre of tube. Tumours pressing upon the larynx and trachea from without. Croup.
Sibilant laryngeal rale.	Passage of air through a larynx diminished in calibre.	Over the larynx and lateral parts of the neck; sometimes heard at upper part of chest, and even without application of the ear or stethoscope to that cavity	Spasm and oedema of glottis Stridulous laryngitis. Foreign bodies in the air passages. Tumours compressing the tube.

Name of the sign.	Physical cause.	Ordinary seat.	Diseases in which observed.
Sonorous laryngeal rale.	Same as sibilant.	Same as sibilant.	Laryngeal ulceration with thickened edges. Vegetations. Croup.
Laryngeal gurgling.	Passage of air thro' larynx and trachea filled with mucus or other fluid.	Larynx and trachea.	Hæmoptysis. Laryngeal ulcerations. Foreign bodies in larynx or trachea. Close of life in various diseases (death rattle).
Tremulous or flapping laryngeal rale	Vibrations of false membranes, caused by passage of air to and from the lungs.	Opposite the larynx, or along the trachea: may even extend to larger bronchi.	Membranous croup, with portions of the exudation partially detached.

CHAPTER SECOND.

AUSCULTATION OF THE CIRCULATORY APPARATUS.

Auscultation of the *circulatory apparatus* is comprised of two distinct branches, which should be separately studied, to-wit: Auscultation of the heart, and that of the *large vessels*.

AUSCULTATION OF THE HEART.

Particular Rules.

In order that the observer may judge correctly of the results derived from auscultation, the patient must remain perfectly calm, so that no artificial disturbance in the circulation may occur to lead him into error. Sometimes, on the contrary, we should induce an acceleration of the heart's movements, in order that the abnormal sounds, before indistinct, may be thus rendered more perceptible. Accordingly, we direct those patients suspected of disease of the heart, to walk rapidly a few steps, and thus are enabled to develope or exaggerate phenomena that otherwise might have remained absent, or so feeble as to escape observation.

Generally speaking, the person to be examined should be in the recumbent position; but as it is often impossible for him to maintain the horizontal posture on account of dyspnœa, the trunk and head may be supported on an inclined plane. Some patients can occupy no other than the sitting posture during the examination. Often it is proper to auscultate our patient first in the recumbent and then in the sitting posture, in order to ascertain if these differences of attitude may not induce variations in the acoustic phenomena. Thus, in certain pericardial effusions,

we hear a blowing sound when the patient is recumbent, which may disappear when he assumes the sitting posture ; and this change of result is no doubt attributable, to the displacement of the liquid, which before compressed the origin of the large vessels, and now gravitates to the inferior portion of the pericardium. To examine the heart from behind, M. Piorry recommends that the patient should be made to sit with his body slightly inclined backwards, in order to bring the organ nearer the posterior wall of the thorax.

The precordial region should be covered with nothing but the shirt ; indeed, it were perhaps better that it should be entirely bare, to facilitate the more exact appreciation of the seat of the stethoscopic sign, and to determine the relationship between this and certain other phenomena sensible to sight, such as bulging, the shock of the apex of the organ, etc. : for such a comparison is not without its importance in our diagnosis.

Ordinarily, the respiratory murmur does not prevent our perception of the heart's sounds : but if the observer be not yet accustomed to auscultate, or if the normal or pathological sounds be feeble or indistinct, he should engage his patient to breathe as gently as possible, or even to suspend his respiration for an instant, when the ear becomes enabled to seize much better the phenomena pertaining to the central organ of circulation. It is scarcely necessary to say this suspension should not be so prolonged as to induce disturbance in the movements and sounds of the heart. As in auscultation of the lungs, the *physician* should select for himself the most convenient position. If he employ the stethoscope, he should stand on the left side of his patient. if he rely upon his ear, he will sometimes find it preferable

to stand on the right side. May we employ exclusively either mediate or immediate auscultation? The precepts already laid down elsewhere on this subject, are applicable here, but with certain restrictions. Generally, we may use the one or the other method indifferently; though with the ear, perhaps, we are enabled to judge better of the grating and friction sounds, because in these cases a tactile sensation is superadded to the acoustic phenomena. The very fact that the area of the stethoscope covers but a limited extent, gives to this instrument greater advantage in determining rigorously the precise seat of a sound, its exact limits, the point of its maximum intensity, and, consequently, deciding whether the lesion exists in the right or left heart, in the mitral or aortic valves, etc. Laennec and several of his successors preferred the cylinder furnished with his obturator. This precaution is not without its advantage if we desire to appreciate the impulsion of the heart; because the solid instrument communicates more freely the movements impressed on the thorax by the organ, though it does not seem to us to modify the sounds in a sufficiently marked degree to justify us in preferring it to the ordinary instrument used in auscultation of the respiratory organs.

The observer should not confine himself to an examination of the centre of the precordial region: he should explore beyond the ordinary limits assigned to that region, with the view of embracing an area of greater radius. Indeed, there are cases in which the stethoscopic signs extend beyond the limits traced by pathologists, and change their place as does the heart itself even: thus the beats are sometimes heard more to the right side, owing to an effusion in the left pleura pushing the organ behind the

sternum : at other times, on the contrary, the heart is pushed more to the left, or retained on this side by morbid adhesions, from which cause we perceive sounds quite on the outside of the nipple, which cannot be heard in the precordial region. It is not sufficient to have examined the point corresponding with the heart alone : we should apply the stethoscope to different points in this region successively. As the causes of the sounds exist at the same time in both cavities of the organ, we should endeavour to localize the point at which they are at their maximum : then, an abnormal sound being made out, we must endeavour, moreover, to determine whether the normal sounds are best heard in the right or left heart, in order to arrive exactly at the fact whether the pathological phenomenon has its seat in the left or the right chamber of the organ. As, however, an abnormal sound may be produced in the arterial or the auricular-ventricular orifices, we should assure ourselves whether the natural sounds be not audible above or below these points. To this end we should auscultate successively from left to right ; and then from below above, and thus endeavour to determine if the sound has its maximum in one of the four spaces formed by two lines crossing each other in the centre of the precordial region. Again, as will be seen hereafter, we sometimes have occasion to study the sonorous phenomena of the heart, throughout the whole extent of the thorax, in order to appreciate properly their relative intensity in the different points of the chest.

It should be our aim in this investigation to distinguish clearly the sounds of the circulatory system from those belonging to the respiratory apparatus, lest we mistake a friction sound of the pleura for example, for one of the pericardium. This is an important precept, even when we

auscultate in front at the precordial region, since the heart is often overlapped by a lobe of the lung ; and it is necessary to know how to isolate its appropriate sounds from those connected with respiration. After this, they should be considered in their several different points of view, and studied successively in their rhythm, character and pathological modifications. This analysis is not always easy : wherefore, the observer should protract his examination so as to satisfy himself of the accuracy of his perceptions. He should also repeat the exploration several times, and on different occasions, to assure himself whether the acoustic phenomena be permanent or temporary.

We insist on the necessity of rigorously observing all these precepts, because these phenomena are more difficult of perception than those of the respiratory apparatus : and as they are, besides, less numerous and less precise in their morbid signification, this should be an additional motive with us for studying them with serious attention. Thus we shall obtain from auscultation of the heart, results less positive, doubtless, than those furnished us by auscultation of the respiratory organs, but which at the same time are not possessed of less relative utility ; for, thanks to it, we are now enabled to *recognize* diseases, which formerly were scarcely *guessed at* : but, we repeat it, all our attention is indispensable. A neglect of the rules now laid down explains how the observer has sometimes erred in taking auscultation as his guide : these errors, however, should not be imputed to the method, but rather to its false application : *non crimen artis quod professoris est*.

Besides, the science created by Laennec is not completed ; and auscultation of the heart may yet be enriched by new discoveries. The important developments it has under-

gone in our days are a guarantee of its future progress. Let us then turn to the best account the resources it offers at present; and knowing how to do this, let us hope to be able to derive still greater advantage from it hereafter.

Whatever the value of auscultation may be, the observer should not confine himself exclusively to its data; nor should he ever pronounced positively an opinion before having added to the results of stethoscopy, the valuable materials derivable from the other modes of physical exploration, and, above all, from the comparative and complete study of the local and general symptoms. If, as we have seen, the utility of this comparison is incontestable in pulmonary affections, it is even more so in diseases of the heart: the physician is surrounded by too many uncertainties and difficulties in his investigation of disease, to content himself with the exclusive aid of any one method; and he cannot bring to bear too much light upon the darkness that surrounds diagnosis.

§ 1. Physiological Phenomena.

When, in the *normal state*, we apply the ear to the precordial region, we hear a *tic-tac*, constituted by two successive sounds, which are regularly repeated from sixty to eighty times per minute. The first of these sounds, which is dull, deep and more prolonged than the second, coincides with the shock of the apex of the heart against the thorax, and immediately precedes the radial pulse; it has its maximum of intensity between the fourth and fifth ribs, below and a little to the outside of the nipple. The *second* sound, which is sharper, shorter and more superficial, is produced after the pulsation of the arteries, and has its maximum of intensity nearly on a level with the third rib, a little above, and to the right of, the nipple.

Considered in reference to the *rhythm*, these sounds are repeated in the following order : first the dull sound, next a *short pause* ; then the sharp sound, and after it the *long pause* : each of these couples, with the intermediate pauses, constitutes a complete *pulsation*. The pulsations, which in the adult range from sixty to eighty-five, are more *frequent* in childhood : exercise, the moral emotions, etc., also accelerate them. Their *force* varies in proportion to the energy and the rapidity of the heart's contractions, individual idiosyncrasy, and the conformation of the thorax : they are more intense in nervous subjects with narrow and thin chests, etc. Their *extent* is equally variable : distinct at the precordial region, they diminish in proportion as we withdraw the ear from that point : they are also perceived with tolerable distinctness over the right side of the chest anteriorly, whilst posteriorly on the left side they are less marked, and are scarcely perceptible at all on the right side posteriorly. The extent to which they can be heard, varies, also, according as the surrounding organs are more or less capable of conducting sound. Their *tone* presents various shades of character, but they are always distinct and free from harshness and grating.

The mechanism of these sounds has been very differently explained. We give the conclusions to which reflection and experiment have brought our minds on the subject : The series of the heart's movements begins with the contraction of the auricles ; immediately after this comes the contraction of the ventricles, followed by their diastole. The shock of the heart, and consequently the dull sound, coincides with the ventricular contraction and the diastole of the large arteries : the second sound corresponds with the dilatation of the ventricles and the systole of the arteries in the neighbourhood of the heart.

(1.) Table of the Alterations of the Sound of the Heart.



ALTERATIONS OF THE SOUNDS OF THE HEART.	I. IN THEIR SEAT.	{ Displacement of the sounds of the heart.
	II. IN THEIR EXTENT.	{ Circumscribed sounds. Diffused sounds.
	III. IN THEIR INTENSITY.	{ Loud sounds. Feeble sounds.
	IV. IN THEIR RHYTHM.	{ 1st. Frequency. { Retarded sounds. Accelerated sounds. 2d. Order of succession.. { Irregular, intermittent sounds. 3d. Number of sounds... { A single sound. Three or four sounds.
	V. IN THEIR TONE AND CHARACTER.	{ Dull sounds. Sharp sounds. Metallic sounds.
	VI. BY ABNORMAL SOUNDS (vide IIId Table.)	

The *first sound* is produced at the same time by the muscular contractions of the ventricles, and the shock communicated to the inferior face of the sigmoid valves and the pulmonary and aortic columns of blood, by the action of the auriculo-ventricular valves, and the impulsion of the heart's apex against the thorax.

The *second sound* is chiefly due to the action of the sigmoid valves, and to the counter shock of the columns of blood driven into the aorta and pulmonary artery, against the concave surface of these valves.

§ II. Pathological Phenomena.

In the *morbid state*, the sounds present various alterations in their *seat, extent, rhythm* and *tone*: they may also be preceded, accompanied, followed or replaced by *abnormal sounds*.

I. ALTERATIONS IN SEAT.

The sounds of the heart are sometimes displaced; so that their maximum no longer corresponds to the points we have indicated. These *displacements* may depend on lesions of the heart, of the pericardium, of the large vessels, or of the surrounding organs.

The *descent* of the two sounds may be due to tumours situated at the base of the heart, causing its depression; or to hypertrophy with dilatation of the auricles: their *ascent* may depend upon a pushing upwards of the diaphragm; their *lateral displacement* may be owing to effusions of liquid or of gas in the pleural sac; their *displacement backwards*, to tumours in the anterior mediastinum. The morbid adhesions of the heart to the pericardium, rachitic malformations of the thorax, and general or partial hypertrophy, may likewise displace them in different directions.

2. ALTERATIONS IN INTENSITY AND EXTENT.

In certain circumstances the pulsations of the heart are perceived in the precordial region only, and even then with difficulty, so *feeble* have they become, and so imperfectly are they transmitted to the ear. At other times, on the contrary, the sounds are *loud* and ringing: the ear, elevated at the region of the heart by the energetic contraction of the organ, perceives very distinctly the two sounds at all points of the thorax, and sometimes even at a distance, so great has now become their intensity, and so perfect their transmission.

A diminution in the extent and the force of the sounds may depend upon atrophy of the heart, upon concentric hypertrophy, upon softening, on a state of local atony or general debility, upon the existence of an effusion in the pericardium, or upon emphysema of the anterior border of the left lung.

An augmentation in the extent and the force of the sounds may depend either upon hypertrophy with dilatation of the chambers of the heart, upon induration of the muscular tissue of its parietes, upon nervous palpitations or a state of general morbid excitability, and also on alterations of contiguous organs, such as pulmonary hepatization, tubercles, etc.

3. ALTERATIONS IN RHYTHM.

To say nothing of the febrile state, in which the *frequency* of the pulsations may increase to one hundred and forty or one hundred and fifty per minute, there are certain grave affections of the heart in which they exceed this number, and they become sometimes so hurried that it is impossible to count them. The *retardation* of the heart's pulsations,

the number of which may descend as low as thirty, twenty, or even sixteen, is generally dependent upon disease of the cranio-spinal axis, and the action of digitalis. It has likewise been observed associated with alterations of the aortic orifice, and, sometimes, with softening and fatty degeneration of the heart.

The *order of succession* in the heart's beats may be disturbed in very different manners. Sometimes they become alternately increased or diminished in number: at others, they undergo an arrest, the duration of which is equivalent to one entire pulsation; this constitutes an *intermission*: these disorders have not of themselves a very precise morbid signification. At other times, however, the *irregularity* is such, that the beats, confused and tumultuous, no longer preserve any measure whatever, and this fact, when it is permanent, affords strong evidence of various organic lesions of the heart, prominent among which is stricture of the mitral orifice.

Sometimes, again, the disturbance is limited to only one of the elements of the heart's pulsation: thus one of the pauses (ordinarily the long) is more *prolonged*; and this may depend upon an obstacle to the entrance of the blood into the ventricle, when, for example, there is auriculo-ventricular stricture; or else upon prolongation of one of the sounds (ordinarily the first), as is observed in cases of hypertrophy, with stricture of the arterial orifices.

As to the *number of the sounds*, sometimes we have but a single one present; as when the first is so prolonged as to cover the second, which is never observed except when it is transformed into an abnormal sound: sometimes, on the other hand, we hear *three* sounds, a phenomenon this which has been observed in some cases of stricture of the orifices.

it has also been referred to an additional sound caused by an hypertrophied auricle, whose contractions are without sound in the normal state: a doubling of the second sound has also been heard towards the end of some cases of pericarditis. The formation of *four* sounds likewise allies itself to certain organic affections, with stricture of the orifices. Finally, these triple and quadruple sounds are ascribable commonly to a defect of synchronism in the movements of the right and left chambers of the heart, and, oftener still, to the addition of abnormal sounds.

4. ALTERATIONS IN CHARACTER.

The sounds of the heart undergo various modifications relative to their *tone*: they may be either *sharper* or *duller* than in the natural state. The sharp sounds may be referred to a thinning of the walls of the heart; whilst the dull announce, on the contrary, thickening of the valves, and, oftener still, hypertrophy of the parietes of the organ.

The *dry, harsh* sounds coincide sometimes with a certain degree of thickening and rigidity of the valves: the *hoarse* and *muffled* appear to be referable, on the contrary, to a state of softness or swelling of these same membranous flaps.

The *metallic tone* (*metallic tinkle of the heart*) may depend upon nervous palpitations, or a gaseous distention of the stomach. It is sometimes allied to induration of the ventricular parietes, and, in some very rare cases, it may be due to pneumo-thorax.

Besides the changes now enumerated, the sounds of the heart may lose their distinctness, and assume a slight *blowing* or *grating* character. These alterations indicates the first degree of various lesions of the valves and orifices,



1st GENUS: Sounds of blowing...	{	<i>Filing</i> —	
		<i>Sawing</i> —	
		<i>C. Musical sounds, whistling, etc.</i>	
2d GENUS: Friction sounds.....		{	<i>Rustling sound.</i>
			<i>Friction sound.</i>
	<i>Sound of new leather.</i>		
	<i>Rasping sound.</i>		

ABNORMAL
SOUNDS.

whose existence at a more advanced period will be revealed by *abnormal sounds*.

5. ABNORMAL SOUNDS OF THE HEART.

Abnormal sounds, namely, those of which there exists no traces in the physiological state, are divided into two groups : the *blowing sounds*, produced in the cavities of the heart ; and *friction sounds* formed outside the organ, in the pericardium.

1st GENUS—SOUNDS OF BLOWING.

We comprise under this term, *blowing*, properly so called, or *gentle blowing*, *grating*, *fling*, *sawing*, and, finally, the *musical sounds*, as *whistling*, *whining*, etc.

A. SOUND OF BLOWING (BELLOWS SOUND OR MURMUR).—Of all the abnormal sounds this is the commonest : its very name is its best definition. More or less soft to the ear, it is either single or double, that is to say, it may be heard during either the systolic or diastolic action of the heart, or with both movements at the same time.

The blowing sound is heard : 1st. in a large number of *organic diseases of the heart*, such as strictures of the orifices, alterations of the valves, (fibrous deposits and vegetations upon them, insufficiency, etc.), hypertrophy with dilatation, endocarditis, etc.; 2d. in *diseases with alteration of the blood*, anæmia, chlorosis, etc.; 3d. in *nervous derangements of the heart*, palpitations, etc.

If the blowing sound is capable of being heard in affections so numerous and so different, how must we proceed to arrive at its true signification ? The problem to be solved is as follows : *A sound of cardiac blowing being given, is it, or is it not, indicative of organic lesion of the heart ?* In order to decide this first question, we must examine

successively the *tone*, the *time* with which the sound is heard, its *persistence*, its *progress*, and, finally, all the concomitant phenomena.

The sounds of blowing connected with organic disease of the heart, sometimes gentle to the ear, are more commonly harsh, and resemble grating, filing sounds, etc. On the contrary, the blowing, not dependent on such lesions, is almost always very soft. The former may be present either with the first or second sound of the heart; the latter is always confined to the first sound, and is never heard with the second. The former, again, is permanent, lasting for months or years; the latter intermittent and transitory. In the course of time, and in proportion as the lesions of the orifices become more serious and more deeply seated, the first undergoes gradual transformation from a gentle blowing to the musical sounds: the latter constantly preserves its character of softness, whatever the modification in its intensity.

Finally, the former are accompanied by local and general symptoms characteristic of an affection of the heart (dulness on percussion, purring tremors, irregularities in the pulse, considerable cedema of the lower extremities): whereas, none of these phenomena occur in chlorosis or anæmia, at least with very marked or durable characters.

In short, the gentle tone of the blowing, its coincidence with the first beat of the heart exclusively, its intermittence or its short duration, and the absence of certain grave phenomena—such, in general, are the characters of the murmur which is independent of organic lesion of the heart; whilst the blowing indicative of this grave change is characterized by the opposite characters of harshness, of coincidence with both beats of the heart, or with the second of these

only, of permanence, and of combination with other morbid conditions.

The existence of an organic lesion being admitted, by what means shall we ascertain its nature?

Now, the blowing sounds dependent upon pericarditis, hypertrophy, the formation of a clot in the cavities of the heart, are accompanied by particular signs, such as bulging of the chest and dulness on percussion at the precordial region, diminution of the shock, with feebleness and distant character of the sounds and of the heart's action (*pericarditis*); dulness on percussion, increase in intensity of the sounds and the heart's action (*hypertrophy*); sudden manifestation of the abnormal sound, smallness of the arterial pulse (*formation of clots.*) These lesions being discarded, there remain for our consideration in making up the diagnosis, only *the diseases of the orifices and the valves*, which, in regard to their principal effects, may be arranged in two species, viz. *strictures and insufficiencies*.

How are we to know whether there be stricture or insufficiency? To respond to this question we must first satisfy ourselves as to the beat to which the abnormal sound belongs; determine whether it precede or accompany the systole, or whether it coincide with the diastole of the heart: from the data thus obtained we shall be enabled to deduce the morbid signification of the murmur, by picturing before our minds the acts corresponding with each of these movements. Suppose the murmur precede the first normal sound of the heart. In this case it must take place at the moment of contraction of the auricles, and depends upon an obstacle to the free passage of the blood into the ventricles: *the presystolic murmur, then, is the index of a stricture of the auriculo-ventricular orifices.*

Does the murmur coincide with the first sound? In this case it corresponds with the systole of the ventricles, and may be due either to an obstacle that impedes the direct course of the blood through the aortic or pulmonary openings, or to a certain morbid condition that facilitates the reflux of this blood into the auricles: *the systolic murmur, then, indicates—either a stricture of the arterial orifices, or an insufficiency of the auriculo-ventricular openings.*

Finally: is it with the second sound the murmur is heard? Then it corresponds with the diastole of the heart, and, in the immense majority cases, recognizes as its cause a regurgitation of blood into the ventricles: consequently, *the diastolic murmur almost always indicates an insufficiency of the sigmoid valves.*

Where any doubt exists as to the correctness of our diagnosis, more especially with reference to the murmur with the first sound, *the exact determination of the diseased orifice will indicate the character of the lesion in question.* If, for example, we localize an arterial orifice as the seat of lesion in a case where the murmur takes the place of the first sound of the heart, we shall have as a consequence arterial stricture as our diagnosis.

Our diagnosis will be aided also by the consideration of the point at which is heard the maximum intensity of the blowing sound, and by the fact as to whether this propagates itself in the large vessels, or whether it be confined exclusively to the region of the heart. In fact, the blowing resulting from lesion of the sigmoid valves, has its maximum of intensity above the nipple at the base of the heart, and may be propagated to the large arteries; whilst that due to alteration of the auriculo-ventricular valves, has its maximum intensity below the nipple, nearer to the point of the heart, and is not propagated to the large arterial trunks.

Accordingly, if a murmur, during the first sound, have its maximum intensity at the base of the heart, and is propagated to the large arteries, it is the indication of arterial stricture. This same murmur, with the first sound, and having its maximum at the apex of the organ, without propagation in the large arterial trunks, indicates an auriculo-ventricular insufficiency.

It is well to recall the fact that, whilst it is, generally speaking, quite easy to recognize a murmur as allied to the first movement of the heart, it is sometimes quite difficult, nevertheless, to say with certainty whether this same murmur precedes, accompanies or immediately succeeds the systole. In this strait, we must, in order to judge of the value of the sign, endeavour to ascertain whether it be propagated to the aorta, or is circumscribed to the precordial region. In the first case, it indicates a lesion of the aortic orifice, which is always a stricture: in the second, this *murmur with the first sound* signifies an alteration of the auriculo-ventricular orifice, which may be either a *stricture* or an *insufficiency*.

As to *blowing with the second sound*, as this is heard more constantly on a line with the arterial orifices, and scarcely ever on that of the auriculo-ventricular openings, we are justified, from the sole fact of its presence, in diagnosing an alteration of the sigmoid valves; and if it be discovered farther that it propagates itself in the large arteries, there is no longer room to doubt that the lesion in question is in fact *arterial insufficiency*. It follows, that the diastolic murmur is very rarely the indication of an *auriculo-ventricular stricture*, which last lesion is more easily recognizable, as we have already said, by the presence of a pre-systolic murmur.

After having determined the particular orifice diseased, and the nature of the lesion effecting it, nothing farther remains but to decide *whether the alteration belongs to the right heart, or to the left*. We arrive at the solution of this problem by the examination of the *relative seat* of the abnormal sound on one side of the heart, and a comparison of this with the normal sounds on the other. We know that the conditions capable of producing the murmur may exist on both sides, and that one of the two sounds may be altered in the left heart and remain unchanged in the right, and *vice versa*. Accordingly, if we hear at any point of the left side, the maximum of an abnormal sound, whilst, on approaching our ear to the right we discover the natural sound, we must conclude that the lesion and the blowing revealing it belong to the left heart and *vice versa*. Besides, the diagnosis of affections of the left cavities is chiefly confirmed by the existence of alterations in the pulse; and that of affections of the right cavities, by disturbance of the circulation in the large veins, more particularly the jugulars.

Hitherto we have supposed the existence of a *single* murmur at the precordial region: let us now suppose it is *double*. A *double blowing sound* may be dependent upon the four following conditions: 1st. Arterial stricture and insufficiency; 2d. Auriculo-ventricular insufficiency and stricture; 3d. Stricture of the two orifices, arterial and auriculo-ventricular; 4th. Insufficiency of the two orifices.

The same considerations derived from the seat of the blowing, from its propagation, etc., serve also to determine here the lesion with which we have to deal.

Let us add, moreover, that the four complex lesions just enumerated are not all equally common, and that di-²ase

of the valves determining their stricture, (such as thickening and induration of these membranous flaps) are often of a nature capable of causing their insufficiency also. We must therefore conclude from this, *that a double sound of blowing is generally a more positive sign of double lesion of a single orifice*, than of two lesions, one situated at the arterial, the other at the auriculo-ventricular orifice.

And as auriculo-ventricular stricture frequently exists without blowing, it follows, that a double abnormal sound, considered independently of the other elements of the diagnosis, indicates rather arterial stricture and insufficiency, than any of the other three combined alterations: moreover, since disease of the valves are much more frequent on the left than the right side, *a double bellows sound announces ordinarily a stricture of the aortic orifice with insufficiency of the sigmoid valves.*

B. SOUNDS OF GRATING, FILING, SAWING.—These abnormal sounds, of which their names even afford a pretty correct notion, most commonly supplant the first sound of the heart. They are sometimes double, and occasionally mask the second sound as well as the first. They are ordinarily permanent, never disappearing when once they become well established. It is more common, on the contrary, to find them transformed later into the musical sounds. They are almost always accompanied with a sensible *tremor*, which is closely analogous to the sensation conveyed to the hand when resting on the back of a cat whilst purring.

These sounds indicate almost constantly organic alterations of the orifices of the heart, and more frequently strictures than insufficiencies. Their character of harshness indicates in general a greater degree of friction, and consequently,

lesions more pronounced than those of which the simple blowing sounds are the indices: these lesions are, ordinarily, cartilaginous, osseous or calcareous deposits.

C. MUSICAL SOUNDS: WHISTLING, WHINING.—In reality, these are not *sounds* in the sense in which we have used this term, but true musical tones like those we make when we whistle, or similar to the cooing of a dove, or the sibilant rale of bronchitis.

According to M. Bouillaud, these phenomena are nothing more than the most elevated degree, the highest pitch of the common blowing sound, and they presuppose in their extreme degree, nearly the same physical condition. In fact, *they are found to be associated with deep-seated lesions of the valves, and principally with great constriction of the aortic orifice, dependent upon osseous degeneration of the semi-lunar valves, or calcareous deposits upon these.*

In some rare cases of alterations in the blood, such as occur in chlorosis, this musical whistling has been observed, and is totally independent of any organic lesion of the heart; but this affection would tend rather to impart to the cardiac murmur the sibilant character, especially if it be developed in the course of a valvular lesion. This same whistling has occasionally been observed also in simple hypertrophy of the organ, with dilatation of the ventricular cavities.

2d. GENUS.—FRICTION SOUNDS.

PERICARDIAL FRICTION.—Under the generic name of pericardial friction sounds, we classify several phenomena which bear a close analogy to the several varieties of pleuritic friction, and which are the result of similar anatomical conditions. Thus, we distinguish the gentle friction or

rustling; the harsh friction or *crackling*, which is closely analogous to the sound of grating; *the sound of new leather*, which is like the creaking of a new sole under the movements of the foot; and the *rasping* sound, a still harsher species of friction, analogous to that caused by two dense and solid membranes rubbing against one another. *The friction sound indicates the existence of pericarditis with false membranes, and but a small quantity of liquid; or the presence on the anterior face of the heart of certain consecutive alterations.*

The *rustling* sound denotes that the pseudo-membraneous exudation is recent, thin, and of very nearly uniform surface. *Harsh friction* announces that the false membranes are thicker, reticulated, uneven and rough. The *new leather sound* indicates generally that these same false membranes are older, firmer, more resistant, and elastic. Finally, the *rasping* sound is dependent upon the formation of morbid products harder than pseudo-membranes, such as cartilaginous or osseous plates in the false membranes, layers of osseo-calcareous matter developed in the parietal pericardium, or solid concretions lodged in the fibres of the heart, and causing protuberances under the membrane enveloping this organ.

AUSCULTATION OF THE LARGE VESSELS.

If we find in ancient authors traces of auscultation as applied to the chest, there is not even an allusion to it as applicable to the vascular system. It is to Laennec we are indebted for the first rudiments of this branch of the science of stethoscopy; but he pointed out a few only of the most prominent phenomena furnished by the *arteries*.

It was only at a period nearer our own days that this study began to receive new developments, and for these it is especially indebted to M M. Bouillaud and Andral. Later, M. Vernois (1) published an excellent monograph upon the subject, which was followed by the researches of M M. Beau (2) and LaHarpe (3). Finally the labors of Doctors Ward (4) and Hope (5), and, more recently, those of M M. Aran (6) and Monneret (7) have shed new light upon the auscultation of the vascular system, by determining with greater accuracy the true seat of the so-called *chlorotic* sounds.

Particular Rules.

The mode of procedure varies a little according as we wish to auscultate the aorta, the arteries or the veins, either of the neck or of the members. For the examination of the ascending aorta we have recourse indifferently to immediate or mediate auscultation; the ear being better adapted in that of the descending aorta, which we examine at the median line of the back. For the abdominal aorta, the stethoscope is preferable: it alone should be used also in the examination of the arteries and veins of the neck, as well as the vessels of the extremities. When we practice mediate auscultation, it matters little whether or not the stethoscope be furnished with the obturator: in

(1) *Etudes physiologiques et cliniques des bruits des artères*; thèses de Paris, 1837, no: 478.

(2) *Recherches sur les causes des bruits anormaux des artères*; *Arch. gén. de Méd.*, 1838, t. i, et 1845, t. viii.

(3) *Nouvelles recherches sur le bruit de soufflet des artères*. (*Ibid.*, 1838, t. iii.)

(4) *Medical Gazette*, t. xx. p. 7.

(5) *Oper. cit.*, p. 109.

(6) *Arch. Gén. de Méd.*, 1843, t. ii.

(7) *Etudes sur les bruits vasculaires et cardiaques*. (*Union Médicale* 1849, p. 499.)

our judgment it seems rarely necessary. To obviate the compression produced by the application of the ordinary cylinder to an artery, M. Vernois has proposed "to hollow it out at two diametrically opposite points of its circumference, in order to adapt it to the reception of the vessel under examination."

In the practice of vascular auscultation, certain positions are more convenient than others. Whilst the descending aorta is being examined, the patient should generally be seated, his back slightly bent forward. The dorsal decubitus is to be preferred for the ascending portion and the arch, and is indispensable in the examination of the abdominal aorta, especially as it favors the flexion of the knees, and thus relaxes the anterior abdominal walls.

In the examination of the vessels of the neck, we may cause our patient to stand upright, though it is better that he be lying on his back, with his head slightly elevated, because it will be more easy to keep him in a fixed position by this means, and, in the examination of the two sides, give him a perfectly symmetrical position. The neck, also, should be slightly stretched, the chin elevated a little, and the face moderately inclined to the side opposed to that under examination. If the head be too much bent backward or to the side, an exaggerated tension of the cervical muscles results, which may change the nature of the sounds.

The dorsal decubitus is likewise more suitable for examining the vessels of the limbs: if we examine the trachial or radial arteries, the arm should be removed a short distance from the trunk; if it be the crural arteries, the inferior member should be half flexed, the thigh slightly abducted, and the external side of the knee sup-

ported by a pillow, so that the limb may remain immovable without muscular exertion. The examination of the popliteal arteries requires the patient to be lying on his belly, and that the limb be slightly supported by a pillow, so as to obviate too great a tension of the ham, which might cause an alteration in the sounds.

The part to be auscultated should generally be uncovered, as in the case of the vessels of the neck, the arm, and the ham, etc.; and covered with but a thin garment when it is the aorta or the crural artery of a female we desire to examine.

The physician, in the examination of the different portions of the aorta, may place himself indifferently either on the right or the left of his patient. For the arteries or the veins of the neck and the members, he will usually find the side corresponding with the vessel the most convenient for him. As, moreover, the sounds are very variable and very transitory often, he will so graduate the pressure of the stethoscope as that the sounds he shall have once heard and then lost be discovered again, recollecting, however, that, generally speaking, the pressure should be but moderate, in order to avoid a partial narrowing of the calibre of the vessel, and, consequently, the production of an artificial sound.

He should auscultate both sides, moreover, and compare the results obtained from this double examination, which comparison often is not without benefit in enabling him to decide whether the sound depends on a local lesion, or whether it is connected with an alteration of the blood, or an organic disease of the heart. It is scarcely necessary to say, that he should endeavour to have both sides of his patient in identically the same conditions, both as re-

gards the position of the neck and the member, as well as the application of the stethoscope—its perpendicular direction with reference to the artery examined, and the degree of pressure exerted upon it.

A very necessary precaution in the examination of the carotids and jugulars, is, to have care that the cylinder be not directed towards the laryngo-tracheal tube. For the carotids, the stethoscope should be applied above the clavicle, between the two inferior portions of the sterno-mastoid muscle, or, above this point, between the internal border of this muscle and the larynx. For the jugular veins, the instrument should be placed immediately outside the external fasciculus of this same muscle, in the supra-clavicular triangle: it is in this last point, also, we must look for the phenomena furnished by the sub-clavian vessels. Finally, for the other portions of the vascular system, we must be guided by our anatomical acquaintance with the courses of the several vessels, in the selection of the proper place to apply the stethoscope. Let us state before closing, that, in the auscultation of the aorta and the vessels of the neck, it is proper to engage the patient to breathe as gently as possible, or even to suspend, sometimes, momentarily, his breath, to obviate the masking of the vascular sounds by the murmur arising from the passage of air into the air-passages, or the simulating of sounds foreign to the circulation.

Under this head we shall study in turn the sounds furnished by the *aorta*, the *arteries* and the *veins*. In the *normal state* we hear along the course of the *thoracic aorta* two sounds which the ear is incapable of distinguishing from those of the heart: whereas, along that of the ventral aorta we perceive but a single sound corresponding with

the diastole of the vessel. In the *arteries* near the heart the same two sounds are heard ; whilst in those more distant from this organ, but one is audible, and it becomes less so in proportion as we examine at a distance from the central organ of circulation. Finally, the *veins* offer no trace of sound whatever, appreciable by the ear.

In the pathological state, abnormal sounds are heard in both these portions of the vascular system.

1. AORTIC SOUNDS.

Diseases of the aorta sometimes reveal themselves by a *single sound*, made up of the sound of *blowing*, *rasping* and *sawing* combined, or by a *rustling* sound more or less prolonged ; sometimes by a *double sound analagous to that of the heart*, or *double blowing* ; or, finally, by a *clacking* preceded or followed by a *blowing sound*. Of these sounds, the former are due to the transmission of the sounds formed in the heart ; the latter are peculiar to the aorta itself when in certain diseased states.

Generally, the morbid sounds are double over the thoracic aorta, and simple in that portion of the vessel within the abdomen. They may indicate numerous lesions either at the orifice itself of the aorta, such as stricture or insufficiency ; or of the interior of the vessel, as cartilaginous or pseudo-membraneous deposits, osseo-calcareous incrustations, erosions of the internal membrane, stricture, dilations, aneurisms in form of a pouch, and varicose aneurisms.

The signs of stricture and insufficiency of the aortic orifice having been already given, let us only recall here the phenomena that characterise the diseases of the vessel itself.

A rude murmur, or the grating sound, perceived exclu-

sively along the track of the aorta, and for a considerable distance, reveals the existence on the internal surface of the vessel, of rugosities dependent upon recently formed false membranes, if there be fever accompanying it ; whilst the same sign, in the absence of fever, points to cartilaginous or calcareous deposits, especially if the patient be aged and has ossification of the radial artery. A gentle murmur perceptible along the whole course of the thoracic aorta, indicates *chloro-ancemia*, especially if it coincide with a similar sound in the vessels of the neck. This same sign limited to a small extent of the aorta, should lead us to suspect the existence of *local stricture* of the vessel, especially if there be energetic pulsations in the vessels given off above the constricted point.

A blowing or grating sound with the first beat, behind the sternum, with dulness on percussion at the same point, and the purring sensation communicated to the hand, indicates *dilatation of the ascending aorta* ; and if this sign be followed by blowing with the second beat, we may conclude moreover that there is insufficiency of the aortic valves.

A systolic blowing and a diastolic murmur, the sounds of the heart itself remaining normal, renders probable the existence of a *pouch-like aneurism*, into which the blood enters and escapes with a sound perceptible to the ear. The diagnosis here is rendered more certain, if, added to the stethoscopic phenomena, there be dulness on percussion, the vibratory tremor and increased impulse ; and, positively so, if a pulsating tumour present itself at the same point.

A double clacking sound analagous to the double sound of the heart, having its maximum of intensity on a level with a tumour agitated by movements of expansion less

marked, suggests the idea of an *aneurismal sac filled with clots*. Finally, an intense, prolonged murmur perceived independently of the sounds of the heart, at one of the points where the aorta is in relationship with the venous system, announces the existence of a *varicose aneurism of the aorta*.

In the *abdominal aorta*, the same morbid sounds just enumerated (generally simple), such as a single exaggerated beat, blowing or grating sound, a murmur, etc., afford a similar pathological signification, according as they coincide with the other phenomena above mentioned.

Finally, we observe sometimes in the abdominal aorta an exaggeration of its normal pulse, without the existence of any material lesion: this sign reveals the morbid state designated by Laennec under the name of *palpitations of the aorta*.

VASCULAR SOUNDS.

It has been seen that, in the physiological state, the arteries near the heart are found to give out two sounds, whilst those more remote from this organ produce but one, which is the true arterial sound. In the pathological state, we sometimes find in the carotids and sub-clavian arteries several of the cardiac sounds, whose origin exists at the diseased orifices of the central organ. Thus, the gentle or rude blowing dependent upon aortic stricture, will transmit the same characters of sound to the carotid at the moment of diastole; and, in the same manner, the blowing sound indicative of insufficiency of the sigmoid valves of the aorta, will be reflected along the carotids at the moment of systole of the heart. The greater part of the abnormal sounds formed in the ascending thoracic aorta, may also be heard, more or less marked, and of the same character, in the

vessels which spring from the arch of that vessel. Thus the sound which passes in an aortic aneurism is propagated to a greater or less distance in the carotid and subclavian arteries. But these are mere phenomena of transmission, and we recognise the nature and the origin of these sounds, by the fact that they have their maximum intensity either at the base of the heart, or at a point in the course of the aorta.

The study of these pathological sounds transmitted to the carotids serves principally to complete that of the abnormal sounds of the heart: it aids us in fixing the proper value to these last as producing causes, and consequently, in discovering the orifice which is the seat of the anatomical lesion, rather than in localizing the existence of alterations belonging properly to the arteries themselves. The propagation of these sounds, in combination with the pulsations perceptible to the touch, informs us moreover that the vessels are not obliterated at their origin, and that the circulation, therefore, goes on there properly.

Independently of these phenomena of transmission, there are other sounds, however, which have their origin in the vessels themselves; and in applying the stethoscope along their track, we may sometimes perceive a *blowing sound*, sometimes a *rasping sound*, or else a prolonged *tremor*, renewing itself with each systolic movement of the heart. At other times, and principally in the vessels of the neck, we hear a dull, diffused sound (*simple continuous murmur*); sometimes this is accompanied with sonorous reinforcements at each arterial diastole (*double blowing sound*, or else musical sounds either isolated or mixed with the preceding murmurs (*blowing sounds*).

Of these phenomena, some, intermittent in form, are

produced in the arteries more particularly; the others, more continuous, have their seat, partly at least, in the veins. We shall describe the first under the name of *arterial sounds*, and the second under the denomination of *venous and mixed vascular sounds*.

ARTERIAL SOUNDS.

A. ARTERIAL SOUNDS.—We hear along the track of arteries, sometimes an *intermittent blowing sound*, gentle to the ear, coinciding with the diastolic movement of the vessel, and perceived often over several arteries at the same time, but more frequently over the carotids, and of these the right rather than the left. Sometimes the blowing is harsher: it is a true *grating blowing*, more rarely diffused, and ordinarily accompanied with a purring tremor sensible to the hand. At other times it is a *murmur* more prolonged, acute, commonly limited, and coinciding also with a manifest vibratory tremor.

In general, the louder, ruder and more circumscribed those sounds, the more certainly they announce *organic lesions of the artery*, such as stricture of its cavity, inequality of its internal surface, aneurismal dilatations, compressions by tumours: the continuous murmur is found associated more particularly with varicose aneurisms. The softer and more diffused they are, on the contrary, the more certainly they indicate disorder of the entire economy, a disease of the blood, and particularly *chlorosis* and *anæmia*.

B. VENOUS AND MIXED VASCULAR SOUNDS.—The sounds which we reunite under this title are generally continuous, and offer various shades of tone and character. Sometimes, it is an obscure, diffused murmur, similar to that heard by applying the ear to a large conch shell

(*simple continuous murmur*). Sometimes it is a more intense murmur, continuous as the preceding, but reinforced at each systole of the heart, and which communicates the sensation of two currents pursuing opposite directions (*blowing with a double current*). Closely analagous to the sound emitted by a blacksmith's bellows, it becomes sometimes sonorous in character, and then simulates the noise of a *humming top*, (known in French as *a diable*: hence the appellation given this sound—*bruit de diable*). At other times, finally, we hear either alone, or combined with one of the two preceding varieties of sound, a sibilant and musical sound, formed by a succession of notes variously modulated, and which have been compared to the resonance of a tuning-fork, or to the vibrations of a metallic chord (*musical sound, chant of the arteries*).

These three varieties of sound are very variable in their intensity and their characters. They become modified, increased, diminished by the slightest tension of the parts, or by compression of the stethoscope. They are principally observed in the large vessels of the neck, more on the right side than on the left, and are much more commonly met with in women than in men.

These vascular sounds are almost exclusively dependent upon diseases of the blood: they constitute the most certain indication of *advanced chlorosis* and *anæmia with great diminution of the blood globules*.

CHAPTER THIRD.

AUSCULTATION AS APPLIED TO PREGNANCY.

In the year 1818, M. Mayor, of Geneva, announced that we might hear through the abdominal parietes, the pulsations of the foetal heart : this was the first step in the application of stethoscopy to the study of the phenomena of gestation. But this valuable observation remained unimproved until M. de Kergaradec published, in 1822, the first work which had then appeared on auscultation as applied to pregnancy, and pointed out two phenomena constituting the most certain signs of gestation.

Since then, this new application of Laennec's discovery has given rise to numerous researches and important works in Germany, France and England. Among these we must distinguish the researches of Ulsamer (1), those of Ritgen (1825), the memoir of Bodson and the report of M. Paul Dubois to the Academy of Medicine (December 1831), the works of M. M. Kennedy, Hohl, Jacquemier, Stolz, Nægele, father and son, Carriere, Hope, Cazeaux, Devil-liers, Jr., and Chailly Honore. Finally, M. Depaul, who, in his thesis (2), has dwelt especially upon the stethoscopic indications as a means of recognizing the presentation and

(1) *Annales de Medicine et de chirurgie du Rhin*, t. viii.

(2) *Thesis de Paris*, decembre 1839.

the positions of the foetus, published, in 1847, a "*Complete Treatise on Obstetrical Auscultation*," to which we cannot do better than refer our readers, as well for the bibliography of the subject, as for information upon the most important questions relating to this interesting branch of diagnosis.

RULES.—The greater part of the precepts relative to auscultation of the abdomen, are applicable here ; and to these we have but a few words to add. Thus, the female should be placed in a symmetrical position ; she should be on her back rather than seated or standing, and her legs should be slightly bent, in order to relax the abdominal muscles, and thus admit of their being pressed down and brought in contact with the uterus. Sometimes the trunk should be inclined to one side or the other, in order to assure ourselves whether the sounds be propagated towards the flanks, and persist or become modified by the altered position of the womb : sometimes again it should be inclined forward, so as to withdraw the arteries of the pelvis from the pressure exercised upon them by the uterus.

The physician should select a convenient position for himself, and, whilst he auscultates, he will do well to feel the pulse of his patient, in order the more easily to satisfy himself as to the relation between the uterine sounds and the circulation of the mother. He may use his ear for the detection of these sounds, but generally, the stethoscope will be preferable for the study of their character, for it facilitates their isolation from those produced in the neighborhood, and enables him to fix more accurately their seat, limits, and maximum intensity : besides, with the instrument we can more easily depress the abdominal and uterine walls, and thus approach nearer the foetus.

As the sounds of pregnancy are ordinarily of slight intensity only, often very circumscribed, variable in their seat, and always difficult of detection by the ear but little practised, their study demands a great deal of attention and perfect silence: the examination should be prolonged, repeated at different intervals, and the observer should explore successively all points of the abdomen. The common stethoscope suffices for this purpose, and there is seldom occasion for employing with advantage the curved instrument of M. Nauche (*metroscope*) designed to be introduced into the vagina, in order to examine the inferior segment of the uterus.

STETHOSCOPIC PHENOMENA.—When we examine a woman who has passed the first half of gestation, we hear several sounds, one of which is evidently associated with the circulation of the mother (*uterine blowing*), whilst the others are dependent upon the circulation of the foetus (*double pulsations*), or on its movements in the womb (*sounds of displacement of the foetus*). Besides these sounds, which are generally admitted and easy of detection, there is another more rare, much more difficult to confirm, and which was first pointed out by Dr. Kennedy, and described since by M. Nægele, Jr., under the name of *umbilical souffle*, and by M. Depaul as *foetal souffle*. This sound is constituted either by a simple pulsation, or by a pulsation with blowing: it is synchronous with the double pulsations of the foetal heart, but it is heard independent of these latter and appears to take place in the umbilical cord itself. Indeed, it has been especially observed in cases of twisting of the cord around the neck of the foetus, or in procidentia of this vascular trunk, or even its compression between the back of the child and the uterine walls.

Finally, Dr. Stoltz, of Strasburg, has pointed out another sound, which consists "in a dull and irregular whizzing, like the sound of fermentation." He has observed it in several women carrying dead children, and is disposed to attribute it to decomposition of the foetus in the waters of the amnios. But other observers have failed to find this phenomenon. Without saying more of these exceptional sounds, we shall now pass to those of real value in the diagnosis of pregnancy.

DIVISION OF THE SUBJECT.

In the pregnant woman, when the first half of gestation is passed, several sounds may be heard, of which one is connected with the maternal circulation (the *uterine blowing*), whilst the others are dependent upon the foetus, and are caused either by the pulsations of the foetal heart (*sounds of the foetal heart*), or by its movements in the womb (*sounds of displacement of the foetus*). Sometimes again we perceive a blowing sound synchronous with the foetal pulse, which seems to pass in the cord when this vascular trunk becomes twisted around the neck of the foetus, or simply compressed between the back of the infant and the uterine walls (*umbilical blowing*). This last sound is much more rare and much less important than the preceding phenomena.

A. THE UTERINE BLOWING SOUND is soft, synchronous with the pulse of the mother, more or less prolonged, of a tone sometimes sonorous, sometimes more acute, and sometimes slightly musical even. It is ordinarily heard towards the inguinal region, though it is movable, and is

present or absent without any fixed law. It commonly makes its appearance towards the fourth month, and after the fifth is rarely wanting.

As the uterine blowing is almost a constant phenomenon in pregnancy and very rare in other conditions, it is a very probable, though not certain, sign of gestation; but as also it is wanting in some cases, its absence is not sufficient to exclude the idea of pregnancy.

B. SOUNDS RESULTING FROM THE MOVEMENTS OF THE FŒTUS.—Sometimes this is a sort of shock, either single or repeated; sometimes a slow and prolonged friction sound, communicating the sensation of a body changing its position. These phenomena commonly begin to be perceptible towards the fourth month, and when they are very manifest announce with certainty the presence of a living foetus.

C. SOUNDS OF THE FŒTAL HEART.—These are double beats, similar to those perceived in auscultating a new-born child. They begin to be heard towards the fifth month, and at first are feeble; they then gradually increase in force, and are repeated from 130 to 140 times in the minute. Their frequency and their intensity also undergo momentary variations independent of the maternal circulation.

The region in which they are heard varies in different women, and in the same woman changes from time to time. Generally speaking, however, the double beat becomes more fixed towards the end of pregnancy, and is most commonly found towards the left iliac fossa. Besides these momentary variations in intensity and character, they become changed under the influence of disease in the foetus, into blowing sounds, and entirely cease on the death of the child.

As this sign is scarcely ever wanting after the fifth month, it possesses great value. However, the absence of the double pulsations does not prove the absence of pregnancy; nor has this absence much importance in the first four months, though from the beginning of the fifth, its continuance serves every day more strongly to confirm the presumption of the non-existence of a foetus, without, however, establishing this positively until the full term has expired. Their presence, on the contrary, is the most certain sign of pregnancy.

If this sign be very perceptible in two points distant from each other, there is strong probability of the existence of double pregnancy, and this probability takes the form of positive certainty if the number of the beats is observed to be different on the right and left sides.

The clearness, force, and regularity of the sounds announce that the foetus is in good health: whilst their alteration, weakness, and intermittence discover it to be either suffering or diseased. Finally, an increase of these disturbances and the complete cessation of the double sounds are indications that the child has ceased to live.

DYNAMOSCOPY.

Beside the morbid sounds now passed in review—sounds localised in the different organs of the economy, and resulting from a physical cause, such as the movements of gas or of liquids, there is still another sound—generalised and perceptible in the different solid portions of the body—a sort of uniform and continuous *buzzing* mingled with some crackling, which appears to be connected with the

intimate acts of molecular life, and bears a tolerable analogy to the distant rumbling of a heavily laden wagon.

This sound, in the physiological state, presents different degrees of force, tone, and character : it is generally soft, uniform and permanent, perceptible in all parts of the trunk and members, but always more manifest at the extremity of the fingers than anywhere else.

In the pathological state this *buzzing* becomes stronger and ruder at the commencement of febrile affections. In cases of cerebral hæmorrhage it is *weaker* on the paralysed side ; and it is altogether wanting in members completely paralysed. It often diminishes also in the course of acute and chronic diseases, the degree of its diminution in these cases being ordinarily in proportion to the gravity of the disease ; and its complete disappearance is the indication of imminent danger. It almost always ceases to be perceptible in the fingers five or six hours before death.

The buzzing becomes *accelerated* in the febrile state : it is *unequal*, *interrupted*, and *tremulous* in the paroxysms of fevers and in the period of access of periodic fever : in some cases it becomes *intermittent*, and this alteration of rhythm is a sign of unfavorable portent, all the graver in proportion as the intervals of silence become the more prolonged.

Finally, this sign presents variations in its tone which are often met with in acute diseases of grave nature, and this dissonance and mobility is the index generally of great danger.

But it is particularly with reference to the distinction between real death and that which is only seeming, that an exact idea of this sign is specially important ; and as it does not entirely cease until twelve or fifteen hours shall

have elapsed after death, its persistence is the indication that organic life is not yet entirely extinct: its complete and definitive cessation on the other hand, becomes an additional sign of the certainty of death, and dynamoscopy thus becomes a precious means of guarding against premature interments.

END OF AUSCULTATION.

PERCUSSION.

The origin of percussion dates back to the remotest antiquity. It is highly probable Hippocrates availed himself of it in the diagnosis of certain dropsies. (1). Aretæus certainly speaks of it when he says : *Nam si, præ inflatione, quam verberantur, tympanum quodam modo referant, τυμπανίας nominatur* (2). Galen likewise employed it to distinguish tympanites from ascites and œdema of the abdominal parietes (3). Actuarius also dwells upon percussion in connection with the same disease (4). Paul of Ægina, goes even farther, and speaks especially of the resonance of the superior portion of the belly in peritoneal pneumatosis (5), and of that of the inferior part in uterine tympanites (6).

(1) Aphorisms, sec. iv, aph. ii. Coac. 491, 496.

(2) *De signis et caus. diut. morb.*, lib. II, cap. i, *De hydrope*: Ed. Henr. Stephani, 1567, fol. i, p. 36. A little farther on he says again: "Tympanias autem....auditu sonorus est, nam ad palmæ percussum abdomen sonum edit." Ibid., p. 37.

(3) "Sed ad veram notitiam comparandam pulsare cogimur abdomen, ut attendamus si veluti tympanum resonet." *De dignoscendis pulsibus*, lib. iv, cap. iii. Ed. Kuhn, vol. viii, p. 951.

(4) "....Qui quum ægri abdomen pulsatur, tympani in morem intumescat, τυμπανίας dicitur ..." *De methods med.*, lib. i, cap. xxi. Ed. H. Steph. vol. II, p. 164 G.

(5) "In quâ (affectione) aliquando flatûs copia cum paucissimâ humiditate coacervatur, inter membranam peritonæum, appellatam ac intestina, adeo ut si verberetur superior venter instar tympani sonum edat." *De re med.*, lib., III, cap. xlviij, Ed. H. Steph. vol. I, p. 471 D.

(6) "In his sequitur tumor imi ventris,....et ad digitorum illsionem sonitus tympani oboritur." *De re med.*, lib. III, cap. LXX, *De inflatione uteri*; Ed. H. Steph., vol. i, p. 487 B.

As we come down nearer our own times, the employment of percussion in gaseous effusions becomes frequent. Tagault resorted to it in ascites (1); Lazare Riviere employed it in the diagnosis of uterine dropsy (2) and hypertrophy of the spleen (3). Mention of it is made by still other authors, but these are only scattered facts, incomplete ideas, without the least reference whatever to its application to the chest. No where have these facts relating to percussion been collected together, and arranged so as to constitute a method. Avenbrugger was the first to devote his attention to percussion in a special manner, and therefore may justly be regarded as its inventor. But in spite of the treatise published by him in 1761 (4), his discovery passed almost unnoticed, and percussion very soon fell into oblivion.

Corvisart is entitled to the credit of having revived and extended its use in France. *Immediate* percussion as it was then practised, was not, however, without its inconveniences: its application was restricted, and its data did not always possess the exactitude desirable. It awaited improvement, and it is to M. Piorry that the science is indebted for this. Thanks to a happy modification, percussion now rendered *mediate* has become of more frequent application, and its results are much more precise. At the same time that M. Piorry has fixed the value of percussion

(1) "La tumeur aqueuse ne sonne comme vent, mais comme eau." *Chir. de J. Tagault*, Lyon, 1580, d'après M. Pigne.

(2) "Si a flatibus (uteri hydrops) excitetur, imus ventus percussus sonitum edit.... Si vero ad humore seroso fiat, gravitas major adest in parte, et sonus veluti fluctuantis aquæ." *Riveriæ, Opera Med. omnia*, cap. XII, p. 391, Geneva, 1737.

(3) ".... A tumore flatuoso distinguitur qui murmur ac sonum edit, qui in scirrho (lienis) non reperiuntur." *Ibid.*, cap. iv, p. 333.

(4) *Inventum novum ex percussione thoracis humani*, etc., Vienna.

by numerous experiments on the dead body, he has given us its rules with extreme care, and widened the field of its application by popularising it in a great number of cases to which, before him, it was a stranger. Since then, the employment of percussion has grown in favour from day to day, and in combination with auscultation constitutes at present the most solid basis of diagnosis.

General Rules.

In order that the results obtained from percussion be certain and useful, there are several general rules necessary to be observed in its employment. The physician should, first of all, choose for himself a convenient position : generally speaking, he may place himself indifferently on the right or the left of his patient. It is important that his movements be perfectly free ; that he be able to percuss at a right angle and with uniform force the region he desires to examine. He must also be at a proper distance from the patient—neither too near nor too far off, lest the variations in the force with which he percusses, that may result from inattention to this precept, be attended with a corresponding variation in the sounds produced. He may pass from one side to the other of his patient if the result of the examination be at all doubtful, repeating it alternately in each of these positions. It often happens, that by means of this counter-proof the physician confirms in his own mind a doubtful opinion, or rectifies a previously formed erroneous one.

Percussion may be *immediate*, that is to say, practised directly upon the parts whose resonance we desire to test. In this case we percuss with the extremities of the four fingers brought into contact with each other and in line, and slightly bent, so as to form more or less of a right

angle with the metacarpal bones. Percussion may also be practised with the palm of the hand, or with the stethoscope even, if we desire only to get a general idea of the sonority of the thorax before proceeding to a more regular and more complete exploration.

This last mode of percussion however, is attended with many disadvantages. Generally speaking, the sound thus obtained is obscure and ill-defined, and in order to get it more distinct and clearer, a certain degree of force must be employed, and this may prove painful to the patient, particularly if the parts underneath be the seat of inflammation: over the *mammæ* it is totally impracticable; and it is scarcely less so in fat people, whose thoracic walls are very thick; and in dropsical subjects whose sub-cutaneous cellular tissue is infiltrated with serum: least of all is it practicable over the belly, where the elastic resistance is less even than that of the chest. Nor is it without danger: direct strong shocks thus produced may give rise to serious concussion in the parts struck, and, if too violent, even determine the rupture of a cyst or aneurismal tumour.

Again; a few rapid shocks thus communicated to the thoracic walls enables us to form a general idea of the sonority of the chest, to discover a very manifest alteration of sound, and thus recognise a very extensive lesion; but they fail to discover to us slighter modifications, and cause us to overlook lesions of very limited extent. If, then, we must sometimes content ourselves with this immediate and rapid percussion in cases where the feebleness of the patient forbids a long examination, we should, nevertheless, whenever the choice is left open to us, prefer *mediate percussion* to it.

This consists of interposing a substance of a different

nature between the hand that strikes and the part struck. This procedure possesses over the last an incontestable superiority. The sounds thus obtained are clearer and more distinct; there is need of much less force to obtain these; the intermediate body diminishes the strength of the shock, and, consequently, is less painful to the patient; it may also be prolonged easily, and practised upon delicate and sensitive parts, and is applicable to regions which will not admit of direct percussion; it enables us to recognise lesions but slightly pronounced and of very limited extent; it furnishes us a means of circumscribing diseased organs, of appreciating their forms, and, consequently, of following the material changes that their volume undergoes; finally, by the greater or less resistance experienced by the fingers in this method of percussion, we can form an idea of the different degrees of density of these organs.

The substance interposed in mediate percussion, may be either the pleximeter of M. Piorry, a piece of India-rubber, or the finger of the observer. The pleximeter ($\pi\lambda\eta\sigma\sigma\omega$, I strike, $\mu\epsilon\tau\rho\omicron\nu$, a measure) is a thin plate of ivory, either circular or oval in its form, smooth on both sides and furnished at the two opposite points of its great diameter with verticle plates intended to steady it. Whilst the instrument described is very convenient in percussion of the abdomen and fat breasts presenting a uniform surface, it is less advantageous when we desire to explore the chests of people of thin habit. In these, it is not easy to apply accurately the instrument in the depressed inter-costal spaces without giving rise to pain, and the peculiar resonance of the ivory itself when thus struck, commingling with the sounds furnished by the interior organs, may alter

the purity of these (1). To escape these inconveniencies it has been proposed to employ a flat piece of india-rubber, which may be applied with more exactness and less pain it is true than the pleximeter, but with which it is difficult to obtain much sound. *Digital* percussion then seems to us preferable to the other modes. The finger, composed of both hard and soft parts, resembles in its structure that of the thoracic walls, and causes less alteration in the sounds yielded by these; and pressure with it, when it becomes necessary to make this is less painful; thin and slender, it adapts itself more easily to the intercostal spaces or to depressed parts; flexible, it moulds itself as it were upon projecting parts, or those even rounded in form; and being the organ of touch, it furnishes us the perception of feeling in addition to that of hearing. Finally, and this is a consideration of no small value, the finger is always at the command of the physician who, by the loss of his pleximeter, might be placed in an embarrassing position.

It is upon the index, and better still, the middle finger, that percussion is ordinarily practised, and it should

(1) The following rules have been laid down by M. Piorry for the use of the pleximeter: The instrument should be held firmly fixed between the thumb and forefinger of the left hand, and as accurately upon the part to be examined as possible, *in order that it may thus become a part and parcel of it, as it were.* When we desire to obtain much sound from an organ, the fingers with which we percuss should be held as follows: The fore and middle fingers should be accurately applied one against the other, the middle being slightly bent, on account of its greater length, so that its extremity will not extend beyond that of the forefinger. The thumb is then to be firmly fixed against the articulation of the second and third phalanges of the index finger. These three fingers, thus united, form a very solid whole, whose percussing surface, if the middle finger be slightly flexed, has the extent of the pulp of the forefinger only. It presents the dimension of the extremity of these two fingers united, if they be held on the same plane. (*Du procédé opératoire, etc., p. 44.*)

always be applied prone. In some rare instances it is more convenient, owing to the position of the patient, to percuss upon the palmar surface of the finger placed in supination. The ordinary mode of procedure is as follows: The left hand is applied flat upon the region whose degree of sonority we desire to ascertain, and it is thus firmly held there: the middle finger is now separated from the others and well extended by means of a moderate pressure only if the sub-jacent parts be painful or if the organ under examination be situated superficially, and a greater degree of pressure if there be no pain, or if the organ be deep seated. The movements of the right hand in the act of percussing should be confined exclusively to the wrist: they thus become more accurately measured, more precise, and the shocks are less painful to the patient, whilst at the same time the sounds produced are more distinct. If it be desirable to percuss with more force, by reason of the thickness of the thoracic or abdominal parietes, or of the depth of the viscera; and if the absence of pain permits a more energetic shock, we employ three fingers brought in contact with each other and bent at a right angle. Two fingers will answer if we desire less force, and if the parts percussed are the seat of acute pain or if the organs they cover are superficial, a light percussion with the medius alone will afford us sufficient results.

Generally speaking, we should accustom ourselves to percuss with gentleness, which, besides the advantage it has of being less painful, possesses the additional one of producing the interior sounds in all their integrity. In every case the percussion at first should be moderate, in order that the patient may become accustomed to it: afterwards it may be practised with increasing force until we

attain that degree capable of yielding us the best results. This *superficial* or *profound* percussion is moreover demanded by the difference in situation—either of the organs in their relation to each other, or of their lesions in this or that particular portion of these (1).

The hand with which we percuss should be lowered and raised alternately, and strike several successive blows separated by very short intervals: sometimes a single, quick shock will answer, after which the finger should be immediately withdrawn: at other times, on the contrary, we allow the finger to remain several seconds in contact with the part, for the purpose of arresting the sonorous vibrations, and, consequently, of being the better able to judge thus of the degree of resistance and density of the subjacent organs. It is the rule to begin our percussion at the very centre of the region corresponding with the diseased organ, though sometimes it is more advantageous to commence our exploration in the surrounding parts, and thus progressively arrive at the diseased viscus. Thus, the contrast between the healthy parts and those which are the seat of disease becomes the more evident, and the ear detects the more readily the slightest variations of sound which instantly furnishes evidence of a material alteration, even though this be but slightly marked.

Sometimes it is important to mark by lines, either with the nitrate of silver or, better still, a soft pencil, those points in which the lesion has commenced, and thus desig-

(1) M. Maillott, following the precepts of M. Piorry, expresses himself on this subject as follows: "A slight percussion enables us to appreciate the superficial portions of the lung; by gradually percussing with greater force, we become enabled to judge of the density of the lungs at different depths." (*Traité Pratique de Percussion*, etc., 1843).

nate the boundaries of diseased organs. This accurate circumscription, constantly practised by M. Piorry (1), enables us to follow step by step the progressive or retrograde movement of the disease, and, consequently, may be the source of valuable indications to us relative to the prognosis and therapeutical management of the case.

Besides the general precepts now given for the government of the physician practising percussion, there still remain a few rules relating to the patient proper to be observed. The region examined should be bare, or covered only with a thin garment: silk and worsted coverings should be proscribed because of the sounds produced by their friction.

The position of the patient, generally speaking, should be symmetrical, though this will vary according to the regions to be examined. Sometimes it becomes necessary to change this in the course of an examination, and if we desire, for example, to recognise the existence of an effusion into the pleural sac, and more particularly into the peritoneal—give to the trunk different directions, in order to determine the fluid to the declivitous portions of these cavities.

DIVISION.

Percussion is especially applicable to the *chest* and *abdomen*: it is only exceptionally so to the *head*, *neck* and *extremities*.

SEC. I.—PERCUSSION OF THE CHEST.

This comprises the examination of the *pulmonary* and *circulatory organs*.

(1) See the *Atlas of Pleximeterism*, Paris, 1851.

CHAPTER I.

PULMONARY APPARATUS.

§ I. Special Rules.

In percussion of the anterior portion of the thorax, the patient may stand in an upright position ; but as the body in this position is deprived of support, it is better that he be seated, his back being supported. In either case the arms should hang by the sides, the head be held straight and the shoulders slightly relaxed. Preferable to either of these positions is the dorsal decubitus, the body now being more or less horizontal according to the degree of dyspnœa that may be present. In this posture the thorax reposes upon a resistant surface, the arms are placed by the side of the body, and by causing the patient to throw back slightly his shoulders, so as to stretch moderately the muscles, we endeavor to give to the trunk a perfectly symmetrical position. In percussing the supra-clavicular region, either on the right or left side, the head should be directed alternately to the side opposite that being examined.

In percussion of the lateral portions of the chest, the patient should be seated on a chair, or lying upon the side opposite to that to be examined, with his arms elevated and resting upon his head, or supported by an assistant.

For the exploration of the posterior parts, the sitting position—either in bed or on a chair—is the best the patient can assume, and in every case, his head should be slightly bent, his back vaulted, and his arms crossed or carried in front of him, so that the scapula, removed from the spinal column, may be fixed to the thorax with exactness, and the muscles be slightly on the stretch : too much tension

of the muscles, however, would have the effect of diminishing the sonority of the chest. In some rare cases, the patient is made to get on all-fours, in order that the physician may be the better able to satisfy himself thus whether the dulness be movable and due to the presence of a fluid susceptible of displacement.

A rule of special importance is, to percuss comparatively both sides of the chest in exactly the same manner; and to this end we should alternately percuss the right and left sides in exactly corresponding parts, in the same position, with equal force, during both inspiration and expiration.

§ II. Physiological Phenomena.

Percussion practised upon the different regions of the thorax furnishes very different sounds. A due acquaintance with these varieties of the normal sound is of great importance in our appreciation of their different modifications in the pathological state.

It is difficult to describe in words the natural resonance of the healthy thorax: it is a clear sound, *sui generis*, (*pulmonary*, M. Piorry calls it,) which should first of all be well studied, either by percussion upon the dead body, or, better still, upon healthy individuals, in order to the ready recognition of all the variations it may undergo. It is scarcely necessary to say that this sound varies according to the different degrees of thickness of the thoracic walls. *In front*, it is clear above the clavicle for a short distance, and upon this bone itself; clear and more distinct still in the sub-clavicular region (from the clavicle to the fourth rib exclusively), it loses a little of its clearness, especially in fat people, on a level with the nipple. On the *left side*, it is obscure at the precordial region,

and a little lower down, we again find the pulmonary sound extending to the neighborhood of the seventh rib, at which point it yields place to the tympanitic resonance of the large extremity of the stomach. On the right, it is clear from the top to the bottom of the thorax—that is, to the level of the sixth or seventh rib: from this point it commences to be replaced by the dulness becoming more and more complete as we descend, caused by the presence of the liver.

The median portion of the anterior parietes of the chest—in other words, the sternal region, furnishes at its superior part a clear sound, less pure however than the sub-clavicular; and as we reach the third rib, it becomes more obscure as far as the xiphoid cartilage.

Laterally, in the space bounded on each side by a vertical line drawn from the anterior and posterior borders of the axilla, the pulmonary resonance is very great, commencing in the hollow of the axilla and extending as far as the fifth, sixth or seventh rib inferiorly.

Posteriorly, the resonance exists from the top to the bottom in the inter-scapula region, but it is of medium intensity only, and ceases at the level of the second or third false rib. Beyond this outwardly, in the space bounded exteriorly by a vertical line drawn from the posterior edge of the axilla, we have the supra-spinous region, where the pulmonary resonance is very obscure, owing to the thickness of the thoracic wall; and the infra-spinous region, where there is a little less obscurity of this same resonance. Happily, at these points we are enabled by forcible percussion to distinguish easily the normal elasticity of the walls of the chest, from the resistance which accompanies true pathological dulness. Lower down, in the space cor-

responding with the angle of the ribs, the pulmonary sound reappears with all its clearness. A little lower still, it is replaced by a dulness, owing, on the right to the presence of the posterior edge of the liver, and on the left to the spleen. This inferior boundary is, generally, rather higher on the right side, on account of the pushing up of the diaphragm by the liver. Sometimes on the left side, the pulmonary sound yields place to a tympanitic resonance caused by distention of the stomach.

Besides these varieties of the pulmonary sound dependent upon the difference in regions percussed by us, there are still others ascribable to the age of patients and the physical conformation of the chest. Thus, in some aged people with lean chests, the resonance is slightly greater; and, relatively speaking, very much more marked—indeed, tympanitic almost, in very young subjects, the thinness of whose thoracic muscles accounts for this. Generally, also, the resonance is more intense in proportion to the width of the chest and the thinness of its parietes, and *vice versa*. Nor should we forget that, in rachitic deformities the resonance is ordinarily less, in consequence of the long continued mechanical compression of the lung, and the thickening of the bones of the thoracic frame work. We have often observed these material changes in the pulmonary parenchyma and osseous tissue in children who have died when the rachitis was in its progressive stage.

§ III.—Pathological Phenomena.

In the diseased state, the sound rendered by the walls of the thorax, in those parts corresponding with the lungs, offers numerous varieties both in degree and character. Sometimes it is clearer and more intense, sometimes

less distinct, flatter ; at others again, it is distinguished by a peculiar tone (1).

A.—AUGMENTATION OF RESONANCE manifests itself in two principal forms : in the first variety, the exaggerated sound obtained by percussion preserves the character of the natural resonance of the chest (*clear sound*) ; in a higher degree it assumes a resonance similar to that obtained in the left hypocondrium when the stomach is distended by gas (*tympanitic sound*).

a.—The *clear sound* itself may be more or less marked : it may be either general or partial, and heard over the whole surface of the chest or confined to a limited region on one or both sides of the thorax.

As the resonance varies much in the normal state, it is not always easy to say in a given case whether it be really in excess, especially when every part of the chest is resonant : in this case we must take into consideration the conformation of the chest, and its size compared with the developments of the soft parts. When the increase of resonance is partial only, it is easier to establish it. However, when this is found on both sides in corresponding points, a doubt may arise in the mind here again as to its

(1) M. Skoda has given particular attention to the *tone* of the sounds elicited by percussion. M. Woillez who has likewise applied himself in a special manner to this study, proposes the following division : “ Whatever be the sound obtained, says he in an important memoir (*Etudes sur les bruits de percussion thoracique*, *Arch. génér. de méd.*, Mars et Avril. 1855), it should be studied as a compound having three fundamental elements worthy each of a separate examination. Every resonance of this sort presents : 1, a normal *tonality*, either more grave or more acute in its character ; 2, a normal *intensity*, either diminished or augmented ; 3, finally, as a complimentary element, there is the thoracic elasticity under the finger which percusses, which also is either normal, augmented or diminished in character (and sometimes also perverted by the hydatidic tremulousness, for example). ”

reality, which can only be removed by recollecting the relative distances pointed out by us as belonging to different regions. Finally, when it is observed in one-half the chest only, we might sometimes be led to regard this side—pathologically more resonant—for that whose resonance is normal, and, inversely, believe the natural sound of the healthy side to be diminished by a morbid state of the lung. Here it behooves us to ascertain whether there be at the same time prominence of the chest, and which of the two sides is the more normally formed and expands with the most regularity: sometimes also we shall have to practise comparative auscultation of the two sides in order to decide the question.

A simple excess of resonance may, as we have already shown, exist independently of any lesions of the organs contained in the thoracic cavity, and be merely the effect of emaciation. Often also it is a sign of lesions of the thoracic parietes or of the subjacent viscera, and is found to accompany *hernia of the lungs* and *sub-cutaneous Emphysema*, though much more frequently it is found associated with *the different forms of pulmonary Emphysema*. It has been established likewise (as desired by Dr. Skoda) in the greater part of the cases of pleuritic effusion, above the level of the fluid (1). Much more rarely is it due to the

(1.) Forty-one times out of fifty-one, according to the observation of one of us, (*Recherches cliniques sur quelques nouveaux signes fournis par la percussion, et sur le son tympanique dans les épanchements liquides de la plèvre*; par M. H. Roger, Archives gén de Méd., juillet 1852). Let us add that in certain cases of pneumonia of the postero-superior portion of the lung, we have an exaggerated sound in front, in the sub-clavicular region.

If this excess of resonance in pneumonia as well as in pleurisy with effusion, should create a doubt as to the value of the phenomenon obtained from percussion, auscultation will serve to determine exactly its morbid signification.

existence of a *pulmonary cavity* or to *dilatation* of the *bronchi*.

When the exaggeration of resonance is the result of *emaciation* only, it manifest itself everywhere with the relative degrees of intensity that we have assigned to the different regions of the chest in the normal state: the inter-costal spaces may be depressed, the clavicles prominent, but the chest preserves still its regular conformation.

Emphysema of the thoracic walls discovers itself still better by tumefaction of the soft parts, and especially by a peculiar crepitation discoverable upon pressure with the fingers, than by the aid of the pleximeter.

Hernia of the lung, without division of the thoracic integuments, is very rare; nevertheless, it does sometimes happen; and if a soft, elastic tumour show itself in any portion of the chest, and give out a very clear sound on percussion, the nature of the case cannot be mistaken.

In *Emphysema of the lung*, the exaggeration of the sound may also be general and extend over the whole chest; but it is rare the resonance does not predominate in one point or another of the thorax, that it is not more pronounced, for example, on a level with the costal cartilages, or else in a portion or in the whole of one side than in the other. Most commonly too, the form of the chest is modified; it is more bulging than in the natural state; the inter-costal spaces are more or less elevated, and the clavicles but little prominent. In partial emphysema, the excess of resonance coincides habitually with more or less appreciable vaulting of the thoracic parietes, especially in the anterior portion of the chest. We will also add that, when the emphysema is tolerably extensive the precordial region itself becomes often very resonant, because the heart is covered by the anterior border of the left lung:

again, that the inferior limit of this exaggerated sound may sometimes descend lower than normally, owing to displacement of the diaphragm (1).

In *pulmonary excavation* it is only exceptionally we find the thoracic resonance increased; and the caverns in these cases must be large, filled with air, and the tissues surrounding them must retain their normal elasticity. Now, these conditions very rarely present themselves associated in one individual, and even when they do, there is not simple exaggeration alone of the ordinary pulmonary sound, but its character likewise is found to be changed; it is remarkable rather for its clearness than its intensity, oftentimes resembling the resonance produced by percussing an empty vessel. The distinguishing characteristic of this clear sound pertaining to caverns, is that it is circumscribed to a small extent, and that it is ordinarily found under the clavicle.

Dilatation of the bronchi also, is but rarely marked by excessive resonance, this lesion being most commonly accompanied with an augmentation in the density of the pulmonary parenchyma.

Finally, the exaggerated resonance sometimes met with in *pleuritic effusion* is distinguishable from the fact that its seat is under the clavicle—above the level of the liquid, and that lower down its place is supplied by a dulness progressively more marked.

(1) We will remark, with M. Skoda, that in *general emphysema of the lung*, which is excessive and accompanied with great tension of the thoracic parietes especially, the sound may not only not be exaggerated, but appear to be even less intense than in the normal state. The same will be observed in *pneumo-thorax* with excessive distension of the pleura and the walls of the chest. (See the experiments contained in the memoir already cited, p. 686).

b.—The tympanatic (1) sound of the chest is perfectly analogous to that obtained by percussion of the left hypochondrium when the stomach is distended by gas. This resonance is observed ordinarily on one side of the chest only: rarely it may be found to extend over one-half of this region, and as a common thing it occupies but a portion of this, of greater or less extent. Frequently it comes on suddenly, at the same time that a dilatation of the pectoral walls of the same side is observed. It is rare for it to continue throughout the extent in which it was first observed, and it speedily becomes circumscribed.

This remarkable resonance indicates a *gaseous effusion into the pleural sac*. Its intensity is generally in proportion to the quantity of gas effused, and a measure of the degree of compression to which the lung has been subjected (2): the extent over which it may be perceived is in relation with the space occupied by the elastic fluid.

It is rare that the tympanitic sound extends throughout the whole of one side, because ordinarily the pneumothorax shows itself in consumptives, in whom the lung has contracted adhesions at the summit of the chest. At the commencement of this pathological state, the phenomenon is sometimes perceptible to the very base of the chest; and as this morbid resonance bears a close analogy to the normal tympanitic sound of the stomach, we might commit

(1) To avoid confusion in the study of percussion, we have used the word *tympanism* in this work in the restricted sense attached to it by Laennec, M. M. Skoda, Woillez and others, use it in a much more extended sense, and as a consequence have met the tympanitic sound in a great number of diseases. (See the "*Traité de percussion*" of the German physician, and the memoir of M. Woillez, "*Du tympanisme dans le pœtrine*." Arch. gen. de Med., sept. 1856).

(2) See end of note, p. 116.

an error and believe we had a case of pneumo-thorax, when in a tuberculous patient, the stomach distended by gas had pushed the diaphragm towards the superior portion of the thoracic cavity : here again, with the aid of auscultation, all doubts can be made to vanish. Besides, the introduction of air into the pleural sac is speedily followed by inflammation of this membrane and a liquid effusion whose presence is indicated by dulness more or less marked.

Auscultation also lends valuable aid to the physician in those cases of differential diagnosis sometimes so difficult, in which the gaseous effusion having formed in the pleural sac slowly and in small quantity, and without simultaneous development of serious functional symptoms, gives rise to slight tympanitic resonance, capable of leading to the belief that the increased resonance is dependent upon pulmonary emphysema only.

B. DIMINUTION OF THE RESONANCE of the chest may likewise be present in various degrees. It is generally divided into two varieties, namely, the *obscure* and the *dull* sound.

a.—The sound is said to be *obscure* when there is still left a certain degree of resonance ; and in this case, the resistance offered to the finger is but little marked generally. This obscurity of the sound may be present also independently of any morbid condition, and depend upon a slight development of the muscles, or thickening of the fatty tissue. We recognise this phenomenon to be non-pathological, from the fact that it is present in corresponding points of both sides of the chest, and that it offers in the different regions where it is observed, the degrees of relative intensity that we have indicated.

Obscure resonance is frequently observed in morbid

conditions—either of the thoracic parietes, the pleura or the lungs.

Tension alone, of the thoracic parietes whatever cause this may depend upon, suffices for the production of a more or less obscure sound. The same may be said with reference to *serous infiltration of the walls of the chest*, though this lesion is better revealed by pitting. *An abscess in the walls* may also give rise to an obscure sound, limited by a circumscribed tumefaction. In some patients affected with intense *pleurodynia*, the pulmonary sound has seemed to us diminished, and this diminution was perhaps ascribable to incomplete expansion of the diseased side.

Much more frequently, however, the obscurity of the sound is referable to lesions more deeply seated. It often exists in *pleurisy*, and is found either at the commencement of this disease, before the quantity of liquid effused is considerable, and especially when the partial adhesions of the two pleural surfaces permit this liquid to ascend between them in the form of thin layer; or later still, when the lung having been for a long time compressed and enveloped with false membranes, can no longer return to its original volume, and the walls of the chest have become depressed. Sometimes, also, the diminution of resonance depends upon a *slight hydrothorax*. In all these cases, its seat ordinarily is at the base of the chest. In simple hydrothorax its position becomes changed with that of the patient. This displacement, on the contrary, is difficult or even impossible in the other affections of the pleura we have just named. Finally, the obscurity of resonance is met with every time the pulmonary parenchyma has lost its lightness and become more dense : in commencing *pneumonia*, *hypostatic engorgement*, *phthisis*, serous or sanguine

ous infiltration of the pulmonary tissue (*apoplexy* or *œdema* of the lung), or as a consequence of *dilatation of the bronchi*, or the development of various morbid productions, such as *cancer* and *melanosis*.

In all these cases the dulness is permanent, and presents no particular character by which we can differentially diagnose it. Nevertheless, in hypostatic engorgement of the lung it is only posteriorly and at the base of the organ that the resonance is diminished; and the same remark may be said to apply almost habitually to pneumonia. In phthisis, on the contrary, it is at the summit of the lung especially, that the obscurity is observed, either posteriorly or under the clavicles. In the other cases, the seat of the obscure sound varies, and, to establish our diagnosis in them, we must necessarily have recourse to other methods.

b.—The sound is said to be *dull* or *flat* when it resembles that obtained by percussing the thigh. It varies both in its seat and extent, occupying sometimes the whole of one side of the chest, or, on the other hand, it may be circumscribed to a limited space. It is generally accompanied with more or less marked resistance to the finger.

Flatness depends either upon considerable induration of the lung, such as that produced by a large deposit of tubercles, or pneumonia in the stage of hepatization; or upon compression of the tissue of the organ by an abundant effusion of serum, blood, or pus: more rarely it is due to the presence of tumours developed in the thoracic parietes, or the pleura, or situated more deeply and in contact with the ribs.

As to *tumours of the walls*, the flat sound merely informs us whether these are solid or liquid; and palpation and other methods of examination are indispensable to the

determination of their nature. *Tumours* seated more deeply, give rise ordinarily to a circumscribed flatness, whose seat however is marked by nothing peculiar. This flatness announces in the point sub-jacent to it, the existence of a dense and compact body, but it is not capable of itself alone, of informing us whether the case in hand be one of aneurism or of a cancerous tumour, and it becomes necessary for us to resort to other means of exploration for *farther light* as to its nature.

Is it possible to distinguish whether the flat sound be attributable to a considerable effusion or an induration of the pulmonary parenchyma? Generally speaking the dulness is more complete in *pleuritic effusion*; ordinarily its maximum is at the base of the chest, and diminishes as we percuss upwards. It ceases at a variable distance from the summit, on a higher level behind than in front, or else, if it reach as far as the clavicles, this fact of its extent alone, taken in connection with its intensity, becomes the indication of an effusion. Another sign of these extensive liquid accumulations, is the displacement of the heart, which, if the effusion have taken place in the left side, may be pushed back by it behind the sternum, and even under the false ribs of the right side. Nor is this all; in the case of partial effusion, it is sometimes possible, in causing the patient to change his position, to produce also displacement of the flatness. This mobility of the phenomenon however, is much less perceptible in *pleurisy* than in simple *hydrothorax*, in which latter affection there is no false membrane, no adhesion, to prevent the liquid from obeying the laws of gravity.

In the case of *pulmonary induration* on the other hand, the flatness will be fixed and immovable, whatever the

position of the patient. Generally also, it is less intense, and rarely occupies the whole of one side : it is most frequently bounded by a varying limit in the thorax, being well marked in a given point and diminishing as we leave this centre, so as gradually to blend itself ultimately with the natural resonance.

If the flatness be due to *pulmonary hepatization*, it occurs on one side only, and along the posterior and inferior border of the lung, more rarely at the summit, and almost never in front.

In the case of *tubercles* on the contrary, it has its seat at the summit, either behind or in front, and often in both sides at the same time : it will be observed also to extend in this case—diminishing in intensity however—as far as the middle portion, but rarely to the base of the chest, unless there be present the complication of chronic pleurisy.

However, in order to establish our diagnosis with some degree of certainty, we should not confine ourselves to the data furnished by percussion alone : we should carefully weigh with these the results obtained by other methods of examination, and not pronounce an opinion until after having compared them with the functional signs and the indications drawn from the progress of the disease.

c.—Besides the modifications of the pulmonary sound by an augmentation or diminution in its intensity, now examined, there is another variety of resonance which deserves to be mentioned.

We have already seen that, at the summit of the chest anteriorly, we tolerably often have a *clear, hollow sound*, circumscribed to a small extent, and dependent upon the presence of a superficial *cavern* containing air only. This clear sound is very rarely analagous to the true tympanitic

sound of pneumo-thorax, nor can the resemblance occur unless the excavation be very large. Much oftener it has a peculiar metallic tone, in the case where the cavern contains at the same time both air and liquid (*hydroæric sound*). This sound may also be observed in pneumo-hydro-thorax, at the point of contact between the gas and liquid, and even in pleurisy or hydro-thorax, either above the level of the effused liquid, or else, according to M. Piorry, in the vicinity of an organ distended with gas, as the stomach or the intestines. Finally, sometimes in percussing the sub-clavicular region, a clear sound accompanied by a slight peculiar click, very similar to that elicited from a cracked vase by gently tapping it with the finger, has been observed: the name given to it is the *sound of the cracked jar*. In order to obtain this last sound distinctly, we should strike but a single blow, at the same time requiring the patient to hold his mouth open. In the immense majority of cases, it announces a *pulmonary cavern*, most frequently tuberculous. It is not always present, and in order that it be so, it is necessary that the cavity be large, that it be superficial, that its walls be thin and elastic and especially that it contain both air and liquid.

SIGNS DISCOVERABLE BY PERCUSSION. (After Dr. F. G. Smith).

Name of sign.	Physical cause.	Ordinary seat.	Diseases in which observed.
Increased resonance.	Diminished density of subjacent parts, and increased portion of air in the lungs.	Variable. May extend over the whole chest, or be confined to the superior regions anteriorly and laterally.	Pneumo-thorax. Hydro-pneumo thorax. Atrophy of lung. Emphysema of lung. Emaciation of subject. Above the level of the liquid in pleurisy with effusion. Hernia of the lung. Dilatation of bronchi (rare).
Tympanitic resonance.	Unnaturally abundant quantity of air in the subjacent parts, together with increased tension of the walls of the chest.	Infra-clavicular and mammary regions; also axillary and infra-axillary regions on either side.	Pulmonary } Atrophous Emphysema } Hypertrophous. Pneumo-thorax. Pneumo-hydro-thorax.
Diminution of resonance. <i>a</i> —(obscure sound).	Intervention of a substance between the walls of the chest	All regions of the chest.	Great muscular development; thick layer of fat. Infiltration of the thorax.

<p>Diminution of resonance. <i>b</i>—(dull sound) with increased resistance of walls.</p>	<p>and the lung, which prevents the transmission of sound.</p>	<p>Increased density of subjacent parts, and diminished quantity of air in the corresponding pulmonary tissue.</p>	<p>cic walls; abscess in the walls. Pleurisy in early stage with slight effusion, or later, with plastic exudation, or retraction of the walls of the chest. Slight hydro-thorax.</p>
<p>Tubular resonance.</p>	<p>Any condition which brings the larger bronchi unnaturally near the sur-</p>	<p>All regions of the chest, but the bases and summits anteriorly and posteriorly more frequently than the central and lateral regions.</p>	<p>2d stage of acute pneumonia; also chronic pneumonia. Phthisis in all stages. Dilatation of Bronchi. Tumours of thoracic walls. Cancer and Melanosis (rare). Pleuritic effusion. Hydro-thorax. Pulmonary apoplexy. Hydro-pneumo-thorax.</p>
<p></p>	<p>Lower part of infra-clavicular, and upper part of mammary regions. Most</p>	<p>Pleuritic } General (period of retraction) effusion. } Partial.</p>	<p>Accumulation of pus over</p>

Name of sign.	Physical cause.	Ordinary seat.	Diseases in which observed.
	face, and within reach of percussion; or the presence of a solid substance, between those bronchi and the surface.	frequent on left side.	bronchi. Pneumonia (very rare). Dilatation of bronchi. Tubercular cavity of a small (rarely large) size. Chronic consolidation of lung. Cancerous deposit around bronchi.
Amphoric resonance.		Antero-superior part of chest on either side.	Tubercular cavern of large size, with walls generally and equally condensed.
Cracked pot resonance. (<i>Bruit de pot fêlé</i>).	Sudden propulsion of air (forcibly expelled from a large cavern) against the walls of the passages with which it comes in contact.	Antero-superior part of chest on either side.	Tubercular cavern of large size with anfractuous walls, and communicating freely with the bronchi; also large cavern with thin and elastic walls, and containing air and liquid.
Movableness of the limits of dulness of sound.	Movableness of the material causing the dull sound.	Inferior regions of the chest.	Pleurisy, especially at the period of gravitating effusion. Hydro-thorax. Hydro-pneumo-thorax.

CHAPTER II.

CIRCULATORY APPARATUS.

PERCUSSION OF THE HEART AND GREAT VESSELS.

§ I. Particular Rules.

The greater part of the rules now laid down referring to percussion of the pulmonary apparatus, might be repeated here. In general, a slight percussion suffices for the recognition of that portion of the heart which is in immediate contact with the pectoral walls; but in order to obtain an idea of the real volume of this viscus and discover that portion of it hidden under the anterior border of the lung, it is necessary that our percussion be practised with more force in order to elicit sound from a greater depth.

We should also percuss in a vertical direction at first, and then horizontally; oftentimes also it is advisable to determine still more exactly the limits of the dulness in all directions; and in order to the attainment of more accurate results and being enabled to judge of the changes that take place from day to day, it is proper to mark these limits by lines drawn on the body.

§ II. Physiological Phenomena.

The precordial region in the normal state, furnishes an obscure sound, the degree and extent of which are not absolutely invariable. Indeed, the heart being more or less covered by the anterior border of the left lung, we have as a consequence, in our examination of this organ, great differences in our pleximetrical results. However, according to the measurements generally admitted, the normal dulness of the precordial region embraces about two inches in all directions. Superiorly, it commences

about the fourth rib, and extends downward to the sixth ; it has its maximum in the center of this region, and laterally, it becomes merged by degrees in the pulmonary sound. Below and to the left it is replaced by the gastric resonance; below and to the right it is often confounded with the dulness caused by the left border of the liver, which approaches the heart or touches it, so that it is not easy to trace exactly the limit separating these two viscera.

The dulness obtained at the precordiā region by moderate percussion, does not (as has already been stated) indicate the real dimensions of the heart: it points only to the extent of that organ's surface which is in contact with the walls of the chest. To reach those parts hidden by the lung a much stronger percussion is necessary, in which case the obscure sound extends laterally, beyond the limits before named, over a space which varies in proportion to the differences in the volume of the organ, dependent upon age and individuals.

As to the *large vessels* given off from the heart, their presence behind the sternum modifies slightly the resonance of the chest, and, according to the researches of M. Piorry (1), this resonance should be replaced by an obscure sound, quite distinct from the pulmonary resonance. This slight dulness is found over a space of from sixteen to twenty lines in width near the base of the heart, where the aorta and pulmonary artery are connected with each other, and not more than ten to twelve lines where the aorta rises alone behind the sternum.

(1) *De l'examen plessimétrique de l'aorte*, etc., Arch. gén. de Méd., decembre 1840.

§ III. Pathological Phenomena.

The dulness yielded by the precordial region, may, in morbid conditions, be diminished in intensity and extent, and even be supplanted by an excess of resonance. The *exaggerated resonance* is nearly always due to an emphysema of the internal border of the lung which covers the heart; more rarely it coincides with *atrophy* of this viscus, which allows the inner edges of the two lungs to approach each other. Much more rarely still, the excessive resonance depends directly upon a lesion of the heart itself, for instance, the accumulation of gas in the pericardial sac, an exceedingly rare affection. If the sound assume a *hydroæric* tone, it announces a *collection of liquid and gas* in the cavity of the serous membrane.

The modification of resonance under the influence of the pathological conditions of the central organ of circulation, consists much oftener in an augmentation of the natural obscurity of the precordial region: this next becomes changed to a *flatness*, at the same time more marked and more extended, combined with a proportional increase of resistance to the finger on percussion. These phenomena depend either upon the presence of *large clots* in the cavities of the heart, or, more frequently, upon *eccentric hypertrophy* of this organ, or a *liquid effusion in the pericardium* (hydropericarditis, pericarditis), or again, upon the association together of several of these morbid states.

There are certain peculiar characters appertaining to this flatness which enable us to establish a differential diagnosis between hypertrophy of the heart and hydropericarditis. Thus, in this last affection, if the effusion be very abundant, the dulness will occupy a triangular space,

whose base touches the diaphragm. The superior level or the lateral bounds of the flat sound will sometimes be found to vary, moreover, according to the position of the patient, as, for example, when he is seated the transverse diameter of the flat region will be greater than its vertical. We will add also, that, in hydropericarditis, the dulness often comes on and extends rapidly; whilst the same cannot be said of hypertrophy, which is developed slowly. In this disease, the space occupied by the flat sound is ordinarily in proportion with the increase in the volume of the heart, and furnishes us a tolerably correct measurement of it. We should recollect however, that the complication of a pulmonary emphysema, so frequent an accompaniment of organic diseases of the circulatory apparatus, is an obstacle to the accuracy of this measurement.

According to Corvisart and M M. Piorry, Camman and Clark, the results furnished by percussion enable us to extend the diagnosis still farther—indeed, to distinguish dilatation of the heart with atrophy, from dilatation with hypertrophy of its walls; as also to recognize isolated alterations in one or the other of its chambers, &c. In certain cases, a more or less marked and extensive dulness manifests itself along the course of the aorta. Considered alone, this sign would not have much importance for us, since any kind of tumour situated behind the thoracic walls, in the course of this vessel, would betray its presence by the same diminution in the natural resonance. An abnormal dulness in the region of the sternum, however, may announce before any other symptom, the existence of an *aneurism of the ascending aorta*; and an examination of the other concomitant phenomena will serve to establish this first semiological result.

Signs Derivable from Abnormal Position of Heart's Sounds. (After Walshe.)

Name of sign.	Physical cause.	Ordinary seat.	Diseases in which observed.
Detrusion towards the right side.	Considerable solid or fluid accumulation in the left pleura, or emphysematous enlargement of the left lung, <i>pushing</i> the organ in that direction; also, rapid absorption of fluid in <i>right</i> pleura, or gradual contraction of substance of right lung, and consequent tendency to a vacuum on that side, by means of which the organ is <i>drawn</i> to that side.	Behind, or to the right of, lower part of sternum.	<div> <div> Pleuritic effusion. Hydro-thorax. Emphysema. Cancerous deposit. Pneumo-thorax. Hydro-pneumo-thorax. </div> <div> Pleuritic effusion rapidly absorbed. General consolidation, with marked contraction of lung. </div> </div> of left side. of right side.

Name of sign.	Physical cause.	Ordinary seat.	Diseases in which observed.
Detrusion towards left side.	The same, <i>mutatis mutandis</i> , as in the case of displacement towards the right side.		
Elevation.	Diminished volume of upper part of lung from atrophy; also from contraction, both interstitial and of investing false membrane.	Infra-clavicular regions.	Tubercular disease of apex.
Procidentia.	Enlargement of both lungs, pushing the diaphragm downwards, and with it the heart.	Epigastrium.	Emphysema of both lungs.

CHAPTER III.

OF THE UTERUS.

When in the normal state, and empty, the womb, hidden in the lower part of the hypogastrium, is inaccessible to the touch, and completely out of the reach of percussion. But when normally developed by the presence of a foetus, or pathologically by different morbid states, pleximetry as applied to it furnishes us with valuable diagnostic results.

In *pregnancy*, percussion carefully practised, gives (according to M. Piorry,) from the end of the second month, a dull sound, an indication of the development of the uterus. This phenomenon—perceived before we are able to recognize the enlargement of the organ by palpation at the hypogastrium, by *ballottement* from the touch, or, with the stethoscope, by the characteristic sounds of pregnancy—is at this period an important sign, and must serve greatly to increase the probability of gestation. But such a result can be had at this early period in exceptional cases only. Later, in proportion as the uterus increases in volume and rises into the abdomen, we are easily enabled by means of percussion to discover at the hypogastrium a dulness, circumscribed by a curved line with superior convexity, whose extent, form and situation, are in relation with the volume, the configuration and the position, either symmetrical or inclined, of the womb. The characters of this dulness, doubtless, establish strong presumptive evidence in favor of the existence of pregnancy, but they do not afford certainty of this, and of themselves are insufficient to demonstrate whether the development of the uterus

be physiological or pathological ; whether it be due to gestation or to dropsy of the cavity of the organ, or to any other morbid product, such as a mole, fibrous tumour, etc. The presumption of pregnancy becomes increased, if the dulness progress with the regularity proper to gestation ; but this we are not always able to determine, for which reason the semilogical results furnished by pleximetry at this period are inferior in value to those obtainable from auscultation. According to M. Piorry however, percussion facilitates the diagnosis and leads to the recognition of pregnancy by several other characters belonging to the dulness, such as its greater intensity, and the more marked resistance experienced by the finger in certain points corresponding with the foetus, and its less intensity with an obscure sense of fluctuation in the intermediate points ; finally, by its displacement and change of position of the foetus, characters these of the dulness, which fail in the pathological states named above.

By affording similar results, pleximetry is particularly useful in establishing the existense of pregnancy in cases where auscultation fails to detect either the sound of the foetal heart or the placental souffle ; and, a certain extent, it may also aid us to determine the position of the foetus.

In the diseased state, lesions of the uterus almost always reveal themselves by a dull sound on percussion. Thus, in dropsy, slight internal hæmorrhage, or fibrous bodies of large growth, percussion yields a dull sound, whose extent is a measure of the development of the womb, or the dimensions of the tumour. Certain peculiar characters of the dulness besides, may assist in rendering the diagnosis more precise : thus, in *dropsy*, or *internal hæmorrhage*, the

dulness is everywhere the same and without any marked resistance to the finger; the space occupied by it is regularly orvoid, like the uterus itself, whilst in the case of a *fibrous tumour*, the intensity of the dulness is not uniform—some points of the organ offering more or less resistance to the finger, and the form of the space presenting the phenomenon being very irregularly rounded.

It is in infinitely rare cases only, that the uterus yields a *tympanitic sound*: a very small accumulation of gas only in its cavity is capable of producing this phenomenon. This fact has sometimes been observed however, and *uterine tympanitis* may be suspected, if, at the hypogastrium there be discovered an oval tumour yielding a clear sound on percussion, circumscribed in all directions, and invariable in its position.

As to the *uterine appendages*, the lesions most frequently occurring in them and capable of altering the resonance of the lower part of the abdomen, are *cysts* of the ovaries and fallopian tubes, giving rise to a dull sound ordinarily present on one side or the other of the hypogastrium, and which scarcely ever assume a symmetrical position with reference to the median line of the abdomen. The dulness will be the more marked, and accompanied with greater resistance, in proportion as the walls of these sacs are thicker, and their contents the more consistent. The extent of the dulness, combined with palpation, will furnish an approximate measure of the volume of the tumours. So long as they are of moderate dimensions only, cysts of the ovaries and the tubes cannot be confounded with ascites; but the same cannot be said when they fill the whole abdominal cavity. The distinction between these cases may be established by the following

characters: In *encysted dropsy*, the dulness occupies the most prominent region of the belly, whilst the clear sound is found at the sides, where the intestines are pushed away by the tumour. In *ascites* on the contrary, the dull sound is heard in all the inferior portions, whilst in the sub-umbilical region, the presence of the intestines pushed towards the epigastrium and floating on the surface of the liquid, gives rise to a tympanitic sound which contrasts with the dulness of the rest of the abdomen, from which it is separated by a curved line with superior concavity. The fluctuation is much more marked also, in *ascites* than in *encysted dropsy* of the ovary.

END OF PERCUSSION.

APPENDIX.

SYNOPSIS OF THE PHYSICAL SIGNS OF THE MOST COMMON DISEASES OF THE LUNGS. (After Dr. Walshe),

BRONCHITIS.

a. *Idiopathic general Bronchitis, Acute and Chronic.*

PERCUSSION. Diminution of clearness of sound in lower and posterior regions, if there be very considerable accumulation of mucus or muco-pus in the bronchi; *unless under these circumstances sound not perceptibly affected.*

AUSCULTATION. *Respiratory murmurs weak or even temporarily suppressed in the tissue immediately corresponding to the affected tubes; exaggerated in that adjoining, hence especially so in the upper parts of the chest; respiratory murmurs dry and harsh; respiration occasionally incomplete; sibilant and sonorous rhonchi, the former chiefly heard in inspiration, the latter in expiration: mucous rhonchus. When the rhonchi are intense, they may mask the respiratory murmurs altogether.*

d. *Idiopathic Capillary Bronchitis.*

In addition to the signs belonging to bronchitis generally, (and it is to be understood that the dry rhonchi existing in the larger tubes may be absent altogether, or nearly so, in this variety of the disease,) there is discovered by

AUSCULTATION. *True subcrepitant rhonchus at both bases posteriorly; fine mucous rhonchus higher up.*

DILATATION OF THE BRONCHI.

a. *Idiopathic or Primary.*

PERCUSSION. *Diminution of clearness, with shortened duration of sound, and increased resistance of walls: except in cases of extreme rarity. Sometimes the character of the sound distinctly tubular.*

AUSCULTATION. *Respiratory murmurs harsh, bronchial, diffused blowing or (if extensive) cavernous; dry and humid rhonchi of bronchitis, or (if extensive) cavernous rhonchus; bronchophony, or pectoriloquy; bronchial or cavernous cough; intensity of transmission of heart's sounds increased.*

d. *Symptomatic or Secondary.*1. *Of chronic pleurisy.*

The same as in the idiopathic variety; with, in addition the signs of pleurisy terminating in retraction of the side.

2. *Of acute pneumonia.*

The physical signs are masked by those of the disease with which the dilatation is associated.

VESICULAR EMPHYSEMA.

a. *Hypertrophous Variety.*

PERCUSSION. *Increase of clearness and of duration of sound; resistance of walls decreased; character of sound more or less tympanitic; comparatively deficient diminution of clearness of sound at the close of a full expiration; limits of pulmonary sound scarcely reduced at the close of a full expiration.*

AUSCULTATION. *Respiration weak*, in very rare cases suppressed in the affected part, *exaggerated in those adjoining*; *rhythm of the respiratory act divided*; *murmurs harsh*, with *expiration more or less, sometimes enormously prolonged*, and in some cases absent altogether, although inspiratory murmur apparently audible; *sibilant, sonorous, mucous, or subcrepitant rhonchi*, from accompanying bronchitis; vocal resonance unaltered or weaker than natural; intensity of transmission of heart's sounds through the affected part diminished.

SITUATION OF SURROUNDING PARTS. *Heart detruded towards the opposite side, if one lung only affected*; *downwards towards the epigastrium, if both are implicated*; *mediastinum detruded to the opposite side*; *either division of the diaphragm pushed downwards with the subjacent abdominal viscera,—this in some cases only.*

b. *Atrophous Variety.*

The signs derived from *percussion* are the same in this as in the hypertrophous variety; the *auscultatory signs* differ only in the distinct *weakness of vocal resonance* discovered in the atrophous form of the disease; by *inspection* the *expansion* and *bulging*, forming such important characters of the hypertrophous variety, are found either to be wanting or to exist to a much less degree in the present form; the *circular or semicircular bulk of the thorax* is not increased, and the *surrounding parts and organs* are found to have undergone no obvious displacement.

SPASMODIC ASTHMA.

During the Paroxysm.

PERCUSSION. Sound slightly diminished in clearness and duration.

AUSCULTATION. *Intermittent, weak, or suppressed respiration, alternating with exaggerated respiration; the latter occasionally accompanied with the dry rhonchi of bronchitis; rhythm of respiratory murmurs jerking, sometimes incomplete, inspiration being deficient at the close.*

ACUTE PNEUMONIA.

a. *Of a considerable Mass of the Lung.*

First Stage—Engorgement.

PERCUSSION. *Sound less clear than natural, resistance slightly increased.*

AUSCULTATION. *Respiratory murmurs weak, suppressed or masked by rhonchus in the affected parts; exaggerated in those at some distance from it and in the opposite lung; true crepitant rhonchus; vocal resonance somewhat increased; some degree of bronchial cough.*

Second Stage—Red Hepatization.

PERCUSSION. *Sound diminished in clearness, until completely dull, decreased in duration, sense of resistance very much increased; under certain circumstances of locality of the inflammation, character of the sound tubular.*

AUSCULTATION. *Respiration bronchial, or blowing, of either the diffused or tubular varieties; weak in the immediate vicinity of the inflamed part (Grisolle);*

exaggerated in more distant parts and in opposite lung; bronchopony, or, under certain circumstances, broncho-ægophony; bronchial cough; intensity of transmission of heart's sounds increased.

Third Stage—Grey Hepatization, or Interstitial Suppuration.

The signs in this stage are the same as in the preceding one; facts observed of late years tend to render it probable that the occurrence of a peculiar form of mucous rhonchus, in addition to the signs of the second, may announce the supervention of the third stage.

Stage of Resolution.

PERCUSSION. *Dulness of sound less marked than previously and gradually decreasing in amount, with a return of the natural elasticity; the alteration of sound is long, however, in being perfectly removed.*

AUSCULTATION. *Respiratory murmurs weak and harsh; redux crepitant, or sub-crepitant rhonchus; still some bronchophony, gradually disappearing.*

b. Lobular Pneumonia.

[The pneumonia of infancy, and, in a particular form, that preceding the formation of secondary abscesses in the lungs, from the circulation of pus with the blood].

AUSCULTATION. *Respiration exaggerated in some points; harsh, bronchial, or even slightly blowing sometimes in others; occasionally a few cracklings of an imperfect crepitant rhonchus; in children, the dry or humid rhonchi of bronchitis.*

CHRONIC CONSOLIDATION OF THE LUNG.

Chronic Pneumonia.

PERCUSSION. *Sound diminished in clearness and duration, resistance increased; tendency to the wooden or to the tubular character sometimes manifested.*

AUSCULTATION. *Respiratory murmurs weak in the affected spot, harsh, bronchial, or having the diffused blowing character to a slight amount; exaggerated in the neighboring parts; bronchophony; bronchial cough; heart's sounds transmitted with undue intensity; irregular subcrepitant rhonchus in small quantity, occasionally, at the very earliest period of the lapse of the disease into the chronic state.*

PULMONARY ABSCESS.

[In diagnosing pulmonary abscess, the first point to be ascertained is whether the signs of pneumonia have existed in the organ which is suspected to be the seat of purulent collection. Admitting this to be settled in the affirmative, the special signs of abscess will vary according as the pus has been more or less completely evacuated, or is still retained].

a. *Pulmonary Abscess of which the Contents are more or less completely evacuated.*

The diagnosis is grounded generally on the fact of the signs of excavation supervening upon those of pneumonia.

PERCUSSION. *Sound dull, duration short; resistance of walls marked; the note has the tubular, amphoric, or the cracked-metal character in some cases.*

AUSCULTATION. *Cavernous respiration, or blowing of the tubular variety (very rarely amphoric); large mucous, with metallic character, cavernulous or cavernous rhonchus ; pectoriloquy, or, very rarely amphoric resonance ; cavernous cough.*

b. *Pulmonary Abscess of which the contents are retained.*

The signs supervening on those of pneumonia are here necessarily obscure.

PERCUSSION. *The pre-existing dulness of sound becomes more marked in a limited space ; the note may acquire the tubular character.*

AUSCULTATION. *Respiration of the tubular variety of the blowing type intensely marked ; strong bronchophony and bronchial cough.*

PULMONARY ŒDEMA.

PERCUSSION. *Clearness and duration of sound decreased, and resistance of walls increased : these changes are generally moderate in degree.*

AUSCULTATION. *Respiration of persistent weak type, mingled with liquid variety of sub-crepitant rhonchus ; slight bronchophony in marked cases.*

PULMONARY APOPLEXY.

PERCUSSION. *Clearness and duration of sound diminished, resistance of walls increased in proportion to the accumulation in the lung.*

AUSCULTATION. *Respiration of persistent weak type directly opposite effusion ; if the effusion be extensive, the murmurs may be suppressed within a very limited space ;*

beyond the limits of the effusion, respiration exaggerated and harsh, bronchial or even slightly blowing; liquid variety of sub-crepitant rhonchus mingled with larger humid (mucous) rhonchus, if hæmoptysis be present; slight bronchophony.

CHRONIC PHTHISIS.

a. *Stage of Tuberculous Consolidation.*

PERCUSSION. *Sound diminished in clearness and in duration, and resistance increased in the clavicular, infra-clavicular, and supra-scapular regions; the diminished clearness gradually passes into a state of complete dullness, special character of sound, wooden under particular circumstances. If the consolidation be light, and in scattered points, the increase of clearness produced by a full inspiration will be, in comparison with that on the healthy side, very trifling; and on the other hand there will be comparatively a great diminution of clearness at the close of a complete expiration.*

AUSCULTATION. *Respiratory murmurs in the infra-clavicular region, and also usually in the upper scapular, weak, and almost suppressed in some points, exaggerated in others; or harsh, bronchial, or even slightly blowing, with the expiratory murmur particularly marked both in duration and intensity; rhythm of murmurs often jerking; dry crackling rhonchus, gradually passing at the close of this stage into humid crackling; occasional friction sound of the grazing variety in different parts of the chest (rare); bronchophony and bronchial cough*

of gradually increasing intensity; hearts's sounds audible, with unnatural clearness; subclavian murmur.

b. Stage of Softening.

PERCUSSION. *Sound completely dull and of short duration; resistance extremely marked; wooden character of sound now common.*

AUSCULTATION. *Respiratory murmurs masked in the site of softening by abundant humid crackling, sub-crepitant (very rarely by true crepitant), mucous rale of thin metallic character, or cavernulous rhonchus; in the parts adjoining, respiratory murmurs of the diffused blowing type, and intermixed sometimes with the rhonchi; rubbing or even creaking variety of friction sound, audible at the apex before and behind; in lower parts of the lung the respiratory sounds are as described in the first stage. Strong, concentrated bronchophony, nearly allied to pectoriloquy; bronchial cough; heart's sounds transmitted as before.*

SITUATION OF SURROUNDING PARTS. *Heart elevated above its natural position, as also the corresponding divisions of the diaphragm and the subjacent abdominal viscera.*

c. Stage of Excavation of the Lung.

PERCUSSION. *Sound completely dull and of short duration, resistance extreme, conjoined commonly with more or less of the wooden special character; or, under particular conditions of the excavation, sound unnaturally clear and prolonged, the resistance being at the same time marked; the special character of the sound in the latter case, is almost always tubular, amphoric, or cracked-metal like.*

AUSCULTATION. *Respiration cavernous or amphoric, alternating with rhonchi: gurgling or cavernous rhonchus; pectoriloquy, strong concentrated bronchophony or amphoric resonance; cavernous or amphoric cough; metallic tinkling or echo, accompanying respiration, voice, or cough (rare); clicking sound produced by movement of contents of the cavity by the heart's action.*

SUCCUSSION. *Sound of thoracic fluctuation, if there be a cavity of very large size (rare).*

SITUATION OF SURROUNDING PARTS. *Same as in the second stage.*

ACUTE PHTHISIS.

a. *Non-suppurative, Asphyxiating Variety.*

PERCUSSION. *Sound decreased in respect of clearness and duration, with proportionate increase of resistance of walls; this state may be limited to some points, and in others natural sonorousness exists; the diminution of sound becomes more and more marked and general, but does not lapse into complete dulness.*

AUSCULTATION. *Respiration weak in some points, exaggerated, harsh, and slightly bronchial in others; dry bronchial (sonorous and sibilant), or sub-crepitant and mucous rhonchi; bronchophony, if the miliary tubercles be especially congregated towards any particular spot.*

b. *Suppurative Variety.*

The signs of bronchitis, as in the non-suppurative variety.

Upon these supervene *dulness of sound under percussion*, which may become *entirely marked*. Mucous rhonchus with large bubbles, passing into the cavernulous, with metallic character; bronchophony.

PLEURISY.

a. *Dry Period.*

PERCUSSION. *Clearness of sound not perceptibly diminished.*

AUSCULTATION. *Intermittent weak respiration; occasionally, but rarely, grazing variety of friction sound.*

b. *Period of Plastic Exudation.*

PERCUSSION. *Clearness and duration of sound somewhat diminished; if notably so, and the sensation of resistance very slightly but distinctly increased, the plastic matter is abundant; deep respiration will restore, in a great degree, the natural clearness of sound.*

AUSCULTATION. *Intermittent weak respiration; rubbing or even grating variety of friction sound.*

c. *Period of effusion.*c. 1. *Of Laminar Effusion.*

PERCUSSION. *Sound diminished in clearness and in duration; sense of resistance increased: these changes exist to an equal amount all over the chest, and are not influenced by any change of posture of the patient.*

AUSCULTATION. *Deep-seated persistent weak respiration, with harsh or slight bronchial character; friction sound ceases commonly to be audible; vocal resonance louder than natural, and generally having some ægophonic character,—this unnatural resonance being diffused, though commonly most marked towards the angle of the scapula.*

c. 2. *Of Gravitating Effusion.*

PERCUSSION. *The upper part of the chest is found to have recovered in some degree its natural sound; the sound of*

the lower is completely dull and proportionally short, the sense of resistance here extremely marked ; the limits of the dull and clearer-sounding parts are distinguished by a tolerably well-defined line ; the limits of the dull sound commonly change with the position of the patient ; deep inspiration has no influence on the limits or degree of the dull sound.

AUSCULTATION. *Respiratory murmurs suppressed where effusion most abundant, weak where less so ; in some comparatively rare cases, however, the respiration is distinctly audible, and of the diffused blowing type in the parts directly corresponding to the effusion ; above the effusion they are exaggerated, harsh, or bronchial ; friction sound almost always inaudible, sometimes, however, may be slightly detected towards the upper edge of the effusion, where also ægophony is heard, especially towards the angle of the scapula ; ægophony may be absent or replaced by bronchophony,*

c. 3. Effusion with Dilatation and Detrusion.

PERCUSSION. *Sound completely dull, and of short duration where the fluid exists ; resistance extremely marked ; the limits of the dull sound not altered by changing the position of the patient.*

AUSCULTATION. *Respiratory murmurs totally suppressed except close to the spine and under the clavicle, here they are harsh, bronchial, or even slightly blowing, sometimes more extensively audible of the latter type ; friction sound inaudible ; ægophony or other vocal resonance ceases commonly to be perceptible.*

SITUATION OF SURROUNDING PARTS. *Heart and mediastinum detrued to the opposite side ; the corresponding division of the diaphragm depressed with the subjacent abdominal viscera.*

d. *Period of Absorption.*d. 1. *Without Retraction of the Chest.*

PERCUSSION. *Sound gradually recovers its natural clearness and duration, first at the upper then at the lower parts, at the latter it may long retain some degree of dulness; the sensation of resistance alters in the same way; the clearness of sound may sometimes be increased by a full respiration.*

AUSCULTATION. *Respiratory murmurs gradually restored, but remain for a variable time weak and slightly harsh; friction sounds sometimes reappear and continue audible for an indefinite period; ægophony or bronchophony (redux) reappear.*

SITUATION OF SURROUNDING PARTS. *Heart, mediastinum, vault of the diaphragm, and subjacent abdominal viscera, restored to their natural position.*

d. 2. *With Retraction of the Chest.*

PERCUSSION. *Sound dull and of short duration, with marked resistance under the finger at the lower parts; superiorly it is clearer, in the inferior regions it has a wooden character, and at the antero-superior often a tubular one.*

AUSCULTATION. *Respiratory murmurs suppressed at base, at upper parts weak and harsh, or bronchial; this partial restoration may not occur for many months after the commencement of contraction; friction sounds commonly audible, of rubbing, grating, or creaking type; bronchophony and bronchial cough, especially posteriorly.*

SITUATION OF SURROUNDING PARTS. *The vault of the diaphragm and the subjacent viscera are sometimes drawn*

above their natural level ; mediastinum and heart commonly, but by no means always, restored to their natural positions.

PNEUMOTHORAX.

PERCUSSION. *Sound increased in clearness and duration, resistance of walls decreased ; special character of sound tympanitic ; comparatively deficient diminution of clearness at the close of full expiration.*

AUSCULTATION. *Deep-seated, persistent, weak. respiration, if the accumulation be moderate ; respiratory murmurs suppressed, if considerable ; vocal resonance weak in the former case, suppressed in the latter ; metallic tinkling accompanying voice and cough (imperfect and rare) ; intensity of heart's sounds on affected side diminished.*

SITUATION OF SURROUNDING PARTS. *Heart and mediastinum detruded to the opposite side ; corresponding half of the diaphragm and subjacent viscera detruded downwards : these displacements occur only where the quantity of air is very considerable.*

HYDRO-PNEUMOTHORAX.

a. *Simple.*

A combination of the signs of pleuritic effusion and of pneumothorax ; the former at the lower, the latter at the upper part of the affected side.

b. *Fistulous, or by perforation.*

PERCUSSION. *Clearness and duration of sound diminished, and resistance of walls increased at the lower parts ; clearness and duration of sound increased, and resistance of walls diminished at the upper ; special character tympanitic superiorly ; limits of clear and dull-sounding parts changeable with the posture of the patient.*

AUSCULTATION. *Respiration amphoric ; resonance of voice and of cough amphoric ; respiration accompanied by metallic tinkling or echo.*

SUCCUSSION. *Sound of thoracic fluctuation.*

SITUATION OF SURROUNDING PARTS. The same displacements may exist as in pneumothorax.

PLEURODYNIA.

PERCUSSION. *Clearness of sound not perceptibly altered.*

AUSCULTATION. *Respiratory murmurs of intermittent weak type and jerking rhythm.*

LARYNGITIS.

Laryngeal Signs.

AUSCULTATION. *Harsh laryngeal respiration ; sonorous or sibilant laryngeal rhonchus, where obstruction exists to any amount ; valvular laryngeal rhonchus ; if ulceration with secretion on surface, gurgling laryngeal rhonchus.*

Pulmonary Signs.

The great majority of cases of chronic laryngitis (I have never seen an exception to this) are tuberculous ; the lungs therefore furnish the signs of tubercle more or less advanced. When there is much obstruction in the larynx, the signs derived from respiration may be extremely obscure on account of the small quantity of air which reaches the bronchi ; in such cases the signs derived from percussion, inspection, application of the hand, and measurement of the antero-posterior diameter in the infra-clavicular regions, will leave no doubt as to the state of the subjacent lung.

CROUP.

Laryngeal signs.

AUSCULTATION. *Harsh laryngeal respiration ; sonorous laryngeal rhonchus, frequently with a metallic character ; flapping laryngeal rhonchus (where false membrane hangs loosely in the passages).*

Pulmonary Signs.

Those of bronchitis or of pneumonia ; or these signs may be absent, either because the affections named do not exist, or because the laryngeal obstruction interferes both with the production of the respiratory murmurs and of all morbid auscultatory signs. The pulmonary sounds may also be masked in a great measure by the loud laryngeal rhonchus.

THE END.

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THE END.

ERRATA.

Line 13, page 31, for pulmonary *rustling*, read pulmonary *rustling* or *crumpling*.

In fifth space, first column, page 48, for prolonged *respiration*, read prolonged *expiration*.

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